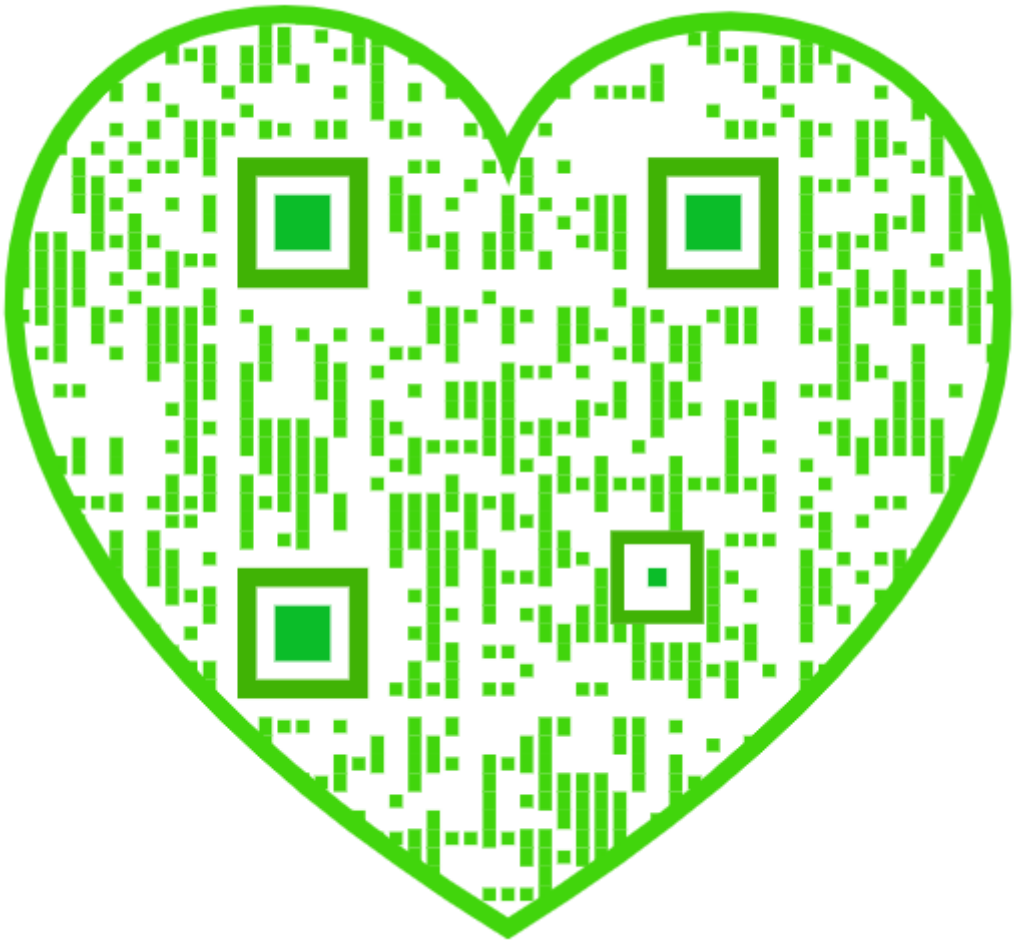

G. B. Simmons. 1908.

BIER'S HYPEREMIC TREATMENT

IN SURGERY, MEDICINE, AND THE SPECIALTIES
A MANUAL OF ITS PRACTICAL APPLICATION

BY

WILLY MEYER, M.D.

Professor of Surgery at the New York Post-Graduate Medical School and Hospital; Attending Surgeon to the German Hospital; Consulting Surgeon to the New York Skin and Cancer Hospital, and to the New York Infirmary

AND

PROF. DR. VICTOR SCHMIEDEN

Assistant to Professor Bier, University of Berlin, Germany

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BY

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PREFACE

THE decision to write and publish in the United States a manual of the practical uses of Bier's hyperemic treatment in surgery, medicine, and the specialties needs no explanation.

Bier's teachings are of such far-reaching importance and great practical value, that there can be no doubt that they will be generally introduced in the United States sooner or later.

Nevertheless, it might be of interest to mention the circumstances that impelled the authors to write this book:

One of them has used Bier's hyperemic treatment in New York since it was first published, fifteen years ago; he was probably one of the first in this country to employ the method. The results he obtained have been so remarkable from the outset that he has greeted with increasing interest every new phase in its evolution, becoming more and more convinced of the value of the treatment as an important addition to our therapeutic resources. Often he has presented patients thus treated in clinics and before medical meetings. Of late he has begun extending its application to the treatment of acute inflammatory troubles, always closely following the rules laid down by Bier. He embodied his experiences in a paper read in the Section on Surgery and Anatomy of the American Medical Association, at its Fifty-eighth Annual Session, held at Atlantic City, June, 1907 (Journal Am. Med. Assoc., August 17, 1907).

The other author came to the United States in May, 1907, as representative of his chief, Dr. August Bier, Professor of Surgery at the University of Berlin, to read, on invitation, a paper on "The Treatment of Bone and Joint Tuberculosis by 'Stauungs-Hyperaemie'" before the Surgical Section of the National Association for the Study and Prevention of Tuberculosis, at its third annual meeting, held at Washington (New York Medical Record, August 17, 1907). Afterward he traveled extensively through the eastern part of the United States, lecturing on, and demonstrating, the procedure, by request, in numerous places, and everywhere he was impressed with the great interest generally shown by the profession. No less was he impressed with the extent to which Bier's treatment is already being employed in America, as well as the unprejudiced and liberal manner in which the new teachings were received where still comparatively unknown.

But one and the same great need so often recognized and complained of by others became apparent to him, wherever he went; namely, that of a brief and comprehensive manual on the hyperemic treatment, that would enable not only the surgeon and specialist in the other branches of medicine, but also the general practitioner to become familiar with the method.

It is in order to fill this gap, that this book has been written. It contains in a nutshell the experiences gathered at Bier's clinic, where the hyperemic treatment had its birth, together with those made on American soil.

WILLY MEYER.
VICTOR SCHMIEDEN.

NEW YORK AND BERLIN.

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BIER'S
HYPEREMIC TREATMENT

WILLY MEYER-SCHMIEDEN

BIER'S HYPEREMIC TREATMENT.

INTRODUCTION.

The physician who intends to make use of artificial hyperemia must first have a clear idea as to what he wishes to accomplish with it. To employ artificial hyperemia means to increase the quantity of blood in a given diseased part of the body, hoping thereby to obtain beneficial results.

The task of the blood is to circulate through all the different tissues of the body, with few exceptions, and to maintain therein the various physiologic functions.

But the blood current accomplishes this not only under normal conditions, but tries to adapt itself also to abnormal states. As soon as the body is invaded by disease or disturbing external influences, requiring an increase or decrease of the blood current, the circulatory conditions become changed.

Everyone who gives this matter some reflection, must come to recognize that the body in such instances, in properly regulating the blood current, does a definite, delicate work, thereby often preventing, or even curing serious disease.

Physicians must learn to recognize in the circulatory blood one of the most powerful factors in the human and

animal system in bringing about the so-called "spontaneous cures."

To explain, a burn may be cited as an example: A hot iron is brought close to the surface of the body. Immediately the skin turns red. We call this the first degree of a burn. This reddening of the skin represents, according to Bier, the body's attempt at protecting the injured part, the accelerated blood current cooling off the heated part and, at the same time, furnishing increased nutrition in the hour of danger.

With the cause persisting, the redness becomes more and more marked, while the sensitive nerves, through the production of pain, bring the imminent danger to the attention of the brain. Soon the cooling blood current proves insufficient. A large accumulation of serum, a blister, developing between the layers of the skin, is furnished by the blood as a further protection against the injurious effect of the heat. To accomplish this, the body has to give up the external layer of the epidermis. We call this appearance of a blister the second stage of a burn.

With the appearance of the eschar, the body throws up the gauntlet, being no longer able to successfully employ the curative reactive inflammation. Necrosis sets in. This is the third stage of a burn.

Definition of the Word Inflammation.

Analogous work is done by the blood current in infectious processes,—although with reduced rapidity in the conspicuousness of the various phases,—when bacterial toxins take the place of the red-hot iron, as shown, for instance, in the inflammatory redness and the edema of a furuncle, a phlegmon, an insect bite, etc. We have the same elemental fight of the system against an invading

foe. The spontaneous disappearance of an inflammation means no less and no more than the victorious fight of the increased blood current against the bacteria.

He who has followed this train of thought will coincide with Bier, that an inflammation—from the physiologic point of view—does not in itself represent a diseased condition, but is a phenomenon indicating the body's attempt to resist a deleterious invasion.

Aim of Bier's Hyperemic Treatment.

To increase this beneficent inflammatory hyperemia resulting from the fight of the living body against invasion, is the aim of Bier's hyperemic treatment.

By deduction from this simple reasoning we are able to discern the first and most important principle underlying Bier's hyperemic treatment, namely:

First Principle Underlying Hyperemic Treatment.

The blood must continue to circulate, there must never be a stasis of the blood. This point is of such paramount importance that it must be stated ahead of and apart from the rules that will be given later for the proper application of the treatment.

Artificial Increase of the Inflammation.

Bier's teachings are of equal importance in explanation of inflammatory processes, as they are in the treatment of the same. If they be correct, we shall have to part with a number of time-honored views, up to the present time accepted as pathologic truths.

Hitherto it was considered the physician's first duty to fight every kind of inflammation, since inflammations were looked upon as detrimental.

Bier teaches just the opposite: namely, to artificially increase the redness, swelling and heat, three of the four cardinal symptoms of acute inflammation.

Hence, all means that tend to subdue an inflammation are to be discarded.

To cite an example: According to Bier, it is a direct mistake if the physician orders the use of an ice-bag at the time of a beginning inflammation. By so doing he resists the healthy reaction of the body; he suppresses the salubrious effect of the inflammation and favors the deleterious influence of the bacteria. The fact that the ice-bag often brings comfort to the patient and reduces the pain, at least temporarily, does not invalidate the truth of the above dictum any more than the fact that an ice-cold drink momentarily comforts a feverish patient.

The same rule obtains here as is generally applied in the case of infectious disease. There are very few physicians today who would attempt to reduce the fever in such cases. We have learned to look upon this fever as one of the weapons of the organism in its fight against the intruder.

It would lead too far, to consider here the many theories advanced in explanation of the effect of hyperemia. This book is to deal with the practical application of the latter. Suffice it to say, that the artificial increase of *all* the symptoms and attributes of the complicated phenomenon, which we call inflammation, evidently is necessary, in order to succeed in conquering the acute inflammation.

The practical results obtained with the hyperemic treatment have proved beyond the shadow of a doubt the absolute correctness of the theories advanced by Bier.

General Part.

CHAPTER I.

THE ADVANTAGES OF THE HYPEREMIC TREATMENT OVER OTHER METHODS.

These are the following:

1. Suppression of the infection.
2. Avoidance of suppuration in many cases.
3. The possibility of using small instead of large incisions in cases in which suppuration has already set in.
4. Hastening the course of the pathologic process.
5. Favoring absorption.
6. Diminution of pain.
7. Its wide field of usefulness.

Suppression of the Infection.

Since it has been demonstrated, that by increasing the inflammatory symptoms a beginning infection can be made to subside, we ought to more generally practise abortive treatment of incipient troubles of this kind; for instance, of incipient phlegmons or furuncles.

Avoidance of Suppuration in many cases.

While it is not possible to suppress every infection before pus is formed, there is no question that by means of artificial hyperemia suppuration can be avoided in a larger percentage of cases than by any of the other therapeutic measures at our disposal.

The Possibility of Using Small Instead of Large Incisions in the Cases in which Suppuration has Already Set in.

In cases in which suppuration is unavoidable even with the aid of artificial hyperemia, owing to the intensity of the infection, Bier's treatment enables us to accomplish with small incisions, what formerly could be achieved with large ones only. This has been shown by manifold practical experiences. The advantage is obvious.

Hastening the Course of the Pathologic Process.

The increased supply of blood hastens markedly the course of a suppuration, inasmuch as it favors the rapid development or demarcation and separation of necrosed portions in soft tissues as well as in bones (rapid formation of sequestra).

Favoring Absorption.

The hyperemic treatment has been found most useful in that it favors the absorption of exudates and pathologic tissue changes of various kinds.

Diminution of Pain.

There is no other method that is superior to hyperemic treatment in point of gentleness and painlessness of application as well as tendency to reduce pain.

Wide Field of Usefulness.

Bier's treatment can be employed to advantage in a large variety of acute and chronic inflammatory diseases. It is applicable and has proven useful in surgery, medicine, and the specialties alike.

CHAPTER II.

METHODS OF INDUCING HYPEREMIA.

There are three methods by which hyperemia may be produced:

1. By means of an elastic bandage or band;
2. By means of cupping glasses;
3. By means of hot air.

1 and 2 produce a passive or venous hyperemia, 3 an active or arterial hyperemia.

The Elastic Bandage.

Retarding the return of the blood to the heart by compressing the veins at the most convenient place between the focus of inflammation and the heart with the help of an elastic bandage or band represents the oldest and typical method of producing artificial hyperemia.

The Germans call this "*Stauungs-hyperaemie,*" a term describing cause as well as effect.

A word, covering the principle of the procedure as this does, is not to be found in the English language. "Obstructive hyperemia" might be suggested, but the word represents the cause only, not the effect. "Stasis hyperemia" would be an absolutely false interpretation of the process. What pathologists call a stasis is exactly what must be prevented in applying artificial hyperemia.

"Congestive," "induced," "artificial-active" and "artificial-passive" or "artificial-arterial" and "artificial-venous" hyperemia also express but poorly the mechanical cause and physiologic effect of the procedure. We think, therefore,

that it would probably be best to take over bodily the word "Stauungs-hyperaemie" into the English language. Every physician, here and abroad, would then at once understand which kind of artificial hyperemia was referred to; viz., the venous one, which can be produced either by the elastic bandage or by suction glasses. The arterial hyperemia, brought on by hot air, is, of course, not a "Stauungs-hyperaemie." It would be best called: "hot-air-hyperemia."

Inasmuch as the word "Stauungs-hyperaemie" has not as yet been adopted, the term "obstructive hyperemia" will be used in place of it in the following pages.

This obstructive hyperemia when produced by means of the elastic bandage can be employed only in diseases of the head, scrotum and testicles, and the extremities. That is to say, in the case of the former the compressing bandage is applied around the neck or the base of the scrotum; in the latter, around the extremity above the inflammatory focus.

In the upper extremities it can be used for affections from the shoulder-joint (inclusive) down to the finger tips. As to the lower extremities, while all portions below the hip can be readily made to profit by the method, it has been found impossible so far, for anatomic reasons, to apply the treatment to the hip-joint itself.

Cupping Glasses.

Where hyperemia by means of elastic compression is not feasible, it can be produced by suction. This method is used upon the breast, back, spine, pelvis, and the surface of the whole body whenever a localized acute infection or an open wound (sinus, granulation, etc.) is present. For this purpose cupping glasses of various size and shape are employed.

As has been said already, the hyperemia produced by the cupping glasses is also principally an obstructive hyperemia.

Hot air is generated in wooden or metal boxes especially constructed to suit the respective case. This represents an arterial hyperemia. **Hot Air.**

CHAPTER III.

GENERAL RULES FOR THE APPLICATION OF HYPEREMIA.

1. OBSTRUCTIVE HYPEREMIA BY MEANS OF THE ELASTIC BANDAGE.

Elastic Bandage.

As has been said before, this is the older and principal method.

This obstructive hyperemia is produced by means of a soft rubber bandage, same as is used for the production of artificial anemia in the case of bloodless operations on the extremities.

In slightly obstructing the return of the blood from the extremity to the heart with the aid of such a soft rubber bandage, the principal point to be observed is that the circulation be never entirely interrupted. What must be our aim is to retard the return of the blood from the extremity under treatment, in this way increasing the quantity of blood normally contained therein, but in no way to interfere with the influx of the blood through the artery. The bandage must be applied firmly enough to slightly constrict the lumen of the thin-walled veins, but not sufficiently so to compress the more resistant walls of the arteries.

One must at all times be able to feel the pulse below the place surrounded by the elastic bandage.

This rule cannot be emphasized too strongly. Nearly all beginners are apt to apply the bandage too tightly.

Yet, it is not difficult to find the proper measure of compression. The patient's own feelings are the best guide, for *the degree of obstructive hyperemia is a correct one, if the patient is not in the least annoyed by the bandage applied.* As soon as the latter unduly constricts, paresthesias will be noticed in the part subjected to hyperemia; then pain will set in. Objectively this mistake can be recognized by the too rapid turgescence of the subcutaneous veins; furthermore, the extremity will assume a bluish-red appearance; a little later there will be red blotches and small subcutaneous hemorrhages will become noticeable. If the constriction is continued, the part becomes cyanotic in appearance and the pulse disappears. As soon as any of these symptoms become evident, the bandage should be removed, and *less tightly* reapplied a little later.

Let it be said again, that there must be no increase of pain, while the bandage is in place. The patient should be requested to inform the physician as soon as pain sets in or already present pain becomes worse. The bandage then should be changed and put on more loosely.

The technique is correct, if there is absolutely no increase of pain and if there is visible hyperemia of the part subjected to the treatment.

On the other hand, the elastic bandage must not be applied too loosely. This would produce a mere obstruction to the return of the lymph, the accumulation of which alone is not wanted. The portion distal to the bandage must appear bluish or bluish-red—*never white.*

The freedom from pain must extend also to the area surrounded by the bandage. Bier employs a *soft* rubber bandage, 2½ inches wide, which he winds around the limb about six to eight times, one layer overlapping the other

Fig. 1.—Demonstrating the application of Bier's elastic bandage around the arm. The flannel bandage is used for padding. This is rarely required. The bandage is 2½ inches wide and is applied so as to have one layer overlap the other by ½ inch. The end is fastened with a pin, but can just as well be tucked under (Fig. 2) or tied with tapes, which are stitched on to the end of the bandage (Fig. 3). The distal part of the extremity shows a distinct obstructive hyperemia. The patient suffers no pain and no annoyance.

by about one-half inch. In this manner the pressure is evenly distributed over a comparatively wide area. The end may be fastened with a safety-pin (Fig. 1) or tucked

under (Fig. 2) or tied with tapes, which are stitched on to the bandage (Fig. 3.) *

Only in cases which require the bandage to remain in

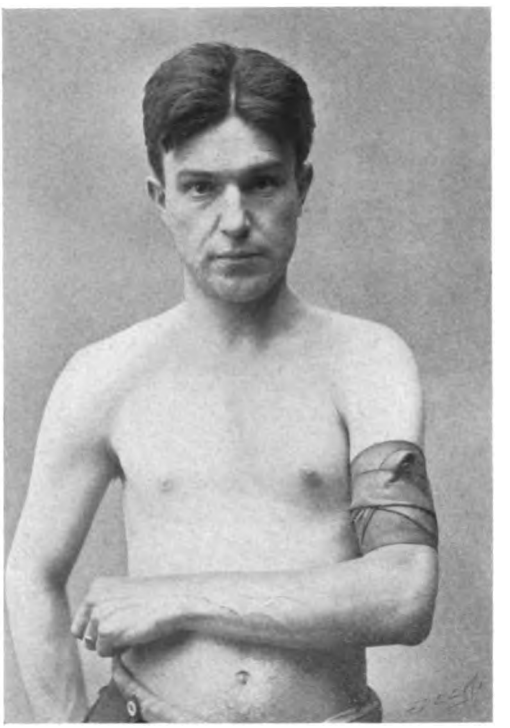


Fig. 2.—This illustration shows the application of the elastic bandage around the arm, with its end tucked under.

place for longer periods, say twenty to twenty-two hours per day, will it be necessary or desirable to first apply a

*Rubber bandages are sometimes very slippery, causing the turns to become loosened, although the end is properly tied with the tapes. In such a case it is advisable to secure the end besides with two strips of adhesive plaster, or moisten the lower surface of the last turn with water.

soft flannel bandage underneath the rubber bandage, in order to avoid pressure necrosis (Fig. 1.) Frequently changing the location of the bandage up and down the

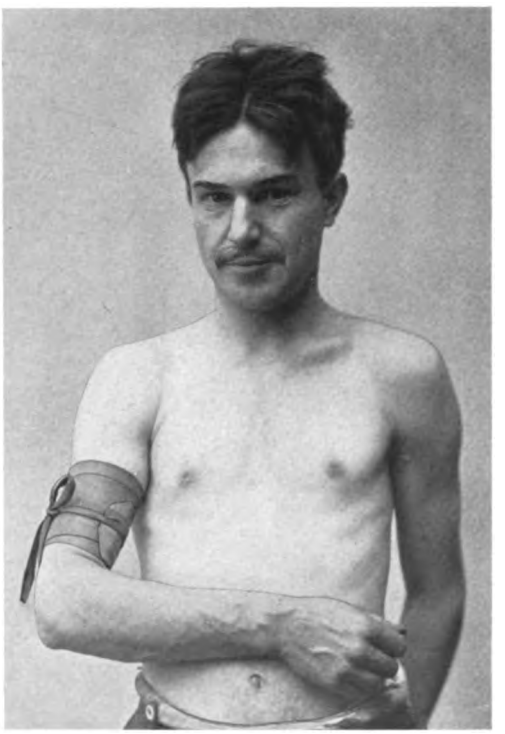


Fig. 3.—Shows elastic bandage in place around the arm, its ends tied with tapes which are attached to the bandage. This is the style of bandage usually found upon the market. If the bandage is to remain on for a number of hours, it is advisable to apply a strip of adhesive plaster, to guard against the tapes' becoming undone. Note the engorgement of the subcutaneous veins of the forearm in Figs. 1 to 3, showing the effect it is desired to produce by the bandage.

extremity, and treating the skin with alcohol rubs, will also be helpful in patients with tender skin.

With the bandage in place, the distal part of the extremity must feel warm, *not* cold.

It is not easy to produce a warm or hot obstructive hyperemia *in a healthy limb;* nor does one always succeed in increasing the temperature of a tuberculous joint in this manner. But every focus of *acute inflammation* subjected to obstructive hyperemia will quickly show increased warmth. First we notice a marked redness, then heat and a swelling. On seeing the swelling increase, the practitioner often becomes frightened, but there is no reason for alarm. According to Bier, this phenomenon is to be looked upon as a welcome, salubrious reaction.

The first effect observed in conjunction with this artificially exaggerated inflammation, is the diminution of pain, becoming more and more noticeable with the appearance of the edema.

This disappearance of pain is best demonstrated in acutely inflamed joints; *e. g.*, a gonorrheal joint. The best proof for a perfect technique is our ability to make passive motions with such joints, about one hour after the application, *without creating pain.*

The elastic bandage must always be placed upon a healthy area, proximally to the seat of the disease. It should never touch the latter.

For affections of the upper and lower extremities it has been made a rule to always apply the bandage around the arm or thigh even though hand or foot be the seat of the disease. It is of no consequence that in such cases the elbow or knee-joint are incidentally also subjected to hyperemia. It never causes an exudation into the healthy joint, not does it ever produce varicose veins. The reason

for so doing is that in forearm and leg the interosseal veins are not sufficiently affected by the elastic compression, and, hence, the hyperemia would be less reliable.

Fig. 4.—Shows a plain towel dressing, as it is best applied during the treatment of, for instance, a phlegmon of the hand. The wounds are loosely covered with aseptic gauze; two safety-pins fasten the towel, which holds the gauze in place without exerting pressure. Every dressing which in any way compresses the diseased parts is harmful, as it interferes with the appearance of a pronounced hyperemia.

Dressings during Obstructive Hyperemia.

All dressings ought to be removed while the compressing elastic bandage is in place, in order to allow the respective part to properly swell and become hyperemic. Wounds

or sinuses are covered with sterile gauze which is kept in place by a towel, loosely wound around the same and fastened by means of a few safety-pins. The extremity rests upon the bed or a table or the patient's lap during the application of the bandage. (See Fig. 4.)

Means of Increasing Obstructive Hyperemia.

If, in cases of chronic diseases a distinct hyperemia does not set in, it is advisable to place the part in a bath as hot as the patient can stand it, for about ten minutes. This will cause the extremity to turn bright red, after which the bandage is applied as described above.

Edema; Intermission of the Obstructive Hyperemia.

Every obstructive hyperemia that is continued for several hours produces edema.

This edema has to be kept within proper limits. The physician or nurse must see to it that it disappears or at least becomes greatly reduced after the removal of the bandage. Of course, it will reappear with the subsequent renewal of the treatment.

During the intermissions, following the application of the elastic bandage for short periods, say from two to four hours each day, this artificial edema always becomes absorbed.

However, in cases requiring a long-continued hyperemia, viz., twenty to twenty-two hours out of every twenty-four hours, in which, therefore, the time for the absorption of the edema is rather short (being reduced to two to four hours), the extremity should be raised on pillows or by means of a suspension splint during the intermission period.

In acutely infected cases the rapid absorption of this inflammatory edema is often followed by some rise of temperature; this, however, is of short duration only.

After the swelling has gone down and before reapplying

the bandage, careful examination should be made to see if any improvement has set in or perhaps pus has collected, even though such an examination may not always be very reliable on account of the edema present.

Abscesses.

The question now arises as to how the physician should proceed in the event of abscess formation during obstructive hyperemia, or when he is called upon to treat by this method inflammatory conditions, that are already complicated with abscess formation.

The idea which may arise in the minds of those who have studied Bier's treatment only superficially—namely, that abscesses now no longer need to be incised—is absolutely erroneous. Such an omission would be fraught with danger to the patient.

Treatment of Abscesses.

It, therefore, should be stated as one of the most important rules that *also under hyperemic treatment every abscess has to be opened.* Every bit of pus should be evacuated. The knife takes care of the pus; hyperemic treatment fights the inflammation.

While there may be no need of particular hurry in the event of a cold abscess, it is essential, that in the case of acute inflammations an abscess should be opened without delay.

Thus, Bier's treatment does not mean any primary change in dealing with an abscess. No matter whether the pus has collected in the subcutaneous tissue, or between the muscles, in sheaths of tendons or within the bones, in joints or behind the drum membrane, always the same dictum holds good: *Evacuate the pus.*

In considering the different affections we shall see, however, that, with the help of the hyperemic treatment,

the large incisions into the abscess cavity, heretofore practised, can be dispensed with; often mere punctures will suffice. These punctures can be made without general anesthesia and naturally heal much more rapidly than large incised wounds; furthermore, there is no need of the painful tamponade in the course of the after-treatment, and there is no extensive scar formation.

The Duration of Application of Obstructive Hyperemia.

Experience has shown that acute inflammatory processes require prolonged application of the hyperemic treatment, from twenty to twenty-two hours per day. In chronic affections, especially those of tuberculous origin, shorter sittings, say two to four hours a day, have been found sufficient.

More definite directions are given later on in the chapters dealing with "Special Diseases." It is there also stated, when it is advisable to combine obstructive hyperemia with other methods, in order to procure the highest feasible degree of hyperemia.

Who is to Apply the Elastic Bandage?

In order to become familiar with the hyperemic treatment, the physician should at first apply the bandages himself. Later he may train, in chronic cases at least, nurses or relatives or even the patient himself to do this, but he must never cease to carefully supervise the treatment, otherwise mistakes or irregularities in the technique may occur which would mar the result.

It is most gratifying to note the real pleasure displayed by intelligent patients as they perceive the gradual improvement that occurs under the application of this gentle and painless treatment, which often renders unnecessary mutilating operations that otherwise would have been unavoidable.

In view of the fact that the subjective symptom of pain is the most important guide to the proper technique, it is really a good plan in chronic inflammations and tuberculous affections to allow intelligent patients to learn how to apply the bandage themselves. However, when it comes to acute processes, the physician must invariably carry out the treatment himself.

The technique above described refers to the treatment of diseases of the extremities.

It is to be regretted that, for anatomic reasons, the hip-joint cannot thus far profit by Bier's discovery. But we have no doubt that some day ways and means will be found to extend the method also to this joint.*

* A few months ago a letter was received from a colleague, in which he proposed, in order to produce a hyperemia, say of the right hip-joint, to apply an Esmarch bandage completely around the upper extremities and the left lower limb and on the right to within one to three inches of the trochanter major. By then placing the patient in a standing or a semiprone posture he expects to produce the desired hyperemia. But this would, at best, but make a slight arterial hyperemia, which could be more easily and more powerfully produced with the help of hot air. What is needed, in acute and chronic (tuberculous) inflammations is an *obstructive*, a *venous* hyperemia. And here lies the difficulty.

Obstructive hyperemia by means of a tourniquet presenting an inflatable pad, over the large abdominal vessels, does not seem unpractical. If applied over the abdomen in order to obstruct the inferior vena cava, it would, of course, incidentally compress the aorta. Still the pressure upon this large vessel would not be great enough to prevent a sufficient amount of blood from passing to the lower part of the body, while its return would be duly impeded. In ascertaining the pulse in the vessels of the lower extremities and by observing the color of the skin of the same, the proper degree of obstruction could always be nicely gauged. Of course, the entire lower half of the body would thus be placed under hyperemia, but this would do no harm as shown by the experience had with joints of the extremities. It remains to be shown by clinical observation, whether a procedure, like the one just proposed, would prove useful, especially whether a patient be able to stand a prolonged compression of this kind.

Another possible solution of the question might be found in large

Shoulder Articulation.

The shoulder *can* be made hyperemic by means of the following special technique: A compress of gauze or other suitable material is folded and tied loosely around the patient's neck. (Fig. 5.) Through its loop a piece of strong rubber tubing is pushed and conducted underneath the axilla around the shoulder. Then the tubing is clamped or tied on top of the shoulder, more or less firmly, according to the degree of constriction desired. Thereupon a piece of bandage is tied on to the rubber tubing, one in front another behind, the two ends being joined in the opposite axillary cavity.

This latter manœuver pulls the rubber ring well over to the sternum and spine, relieving the joint from pressure and at the same time placing it under obstructive hyperemia. A glance at Fig. 5 will explain the application of the tube.

It is plain that the treatment needs more care and attention here than elsewhere, principally for the reason that the elastic pressure is exerted always upon exactly the same spot. The physician, therefore, must be well on his guard to avoid pressure necrosis, as this would render the continuation of the treatment impossible.

Decubitus can be obviated by padding the tube with cotton and frequent interruption of the application.

In order to simplify matters a ready-made, padded rubber ring with attached straps has been recommended

glass apparatus, of the shape of tights, including the entire pelvis, with one rubber cuff around each thigh and another, larger cuff or belt around the abdomen, being adjusted by means of straps and buckles. Here, too, all the pelvic organs would participate in the hyperemia.

Such experiments would, of course, present considerable difficulty owing to the expense that would be connected with the construction of the proper glass apparatus.

for this purpose. Bier himself favors the method above described, as it can be readily improvised by any one and permits of better regulation of the degree of hyperemia.

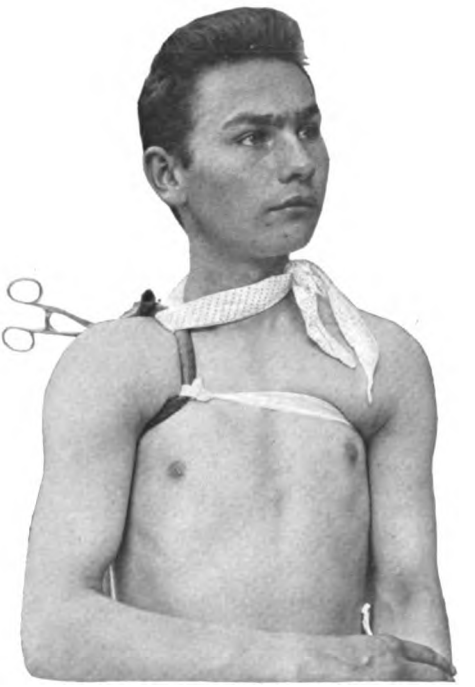


Fig. 5.—Technique employed for the production of obstructive hyperemia at the shoulder-joint. The folded piece of cloth is placed loosely around the neck. A piece of stout rubber tubing, under the required tension, is fastened on top of the shoulder. Two pieces of bandage are attached to the rubber tubing in front and behind and tied in the axilla of the healthy side, pulling the ring thus formed well over toward the median line.

Obstructive Hyperemia of the Head.

Next to the extremities, the head is most amenable to obstructive hyperemia. A strip of garter elastic about three-fourths of an inch wide, with a hook at one end and a number of eyes on the other, to allow for different

degrees of compression, best answers the purpose. (Fig. 6.) If such elastic be not on hand, a piece of black rubber bandage, the last tour or layer fastened with a few short straps of adhesive plaster (Fig. 7), or a narrow band, made from a rubber bandage, with a button at one end and a number of buttonholes at the other (Fig. 8), will be just as efficient.

This band is applied around the neck below the larynx; its tension has to be regulated according to the need of the case.

Here, too, it is of utmost importance not to apply the

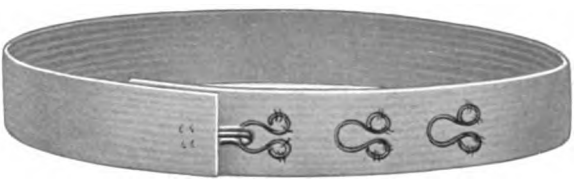


Fig. 6.—Elastic neck-band made of elastic webbing. The bandage is placed below the larynx and can be worn, without showing, underneath a high collar.

band too firmly. *It must never strangulate.* The patient himself must be the judge; he is to promptly report any annoyance. The object of the treatment is to increase the quantity of blood in the head, but the hyperemia must not interfere with the patient's ability to sleep, eat, and drink.

In order to increase the obstruction, a piece of soft felt may be slipped under the bandage at the site of the jugular veins. (Fig. 9.)

Special care must be exercised in the case of patients suffering from arterio-sclerosis. It should, however, be

Fig. 7.—Piece of rubber bandage, used for a neck-band. End fastened with two strips of adhesive plaster. This is used only in cases of emergency, inasmuch as the bandage cannot well be placed below the larynx.

Fig. 8.—Neck-band made of black rubber. One end carries a button, the other has button-holes. This bandage affords greater comfort to the patient, but is not as easily made as the one shown by Fig. 6.

emphasized, that, as a general thing, it is entirely permissible to produce a distinct edema when treating acute inflammatory processes of the head, same as is done in case of the extremities.

Fig. 9.—This figure shows the application of the elastic bandage for the production of obstructive hyperemia of the head. To increase the hyperemia a piece of soft felt is placed over the large venous trunks of the neck beneath the bandage.

Obstructive Hyperemia of the Testicles.

The technique of obstructive hyperemia in diseases of the testicles is simple. Some rubber drainage tubing, best of medium size (about 20 to 25 French scale), is wound around the root of the scrotum over a layer of cotton batting. (Fig. 10.) The ends are secured by means of a small clamp, for instance, such as are used in hare-lip operations

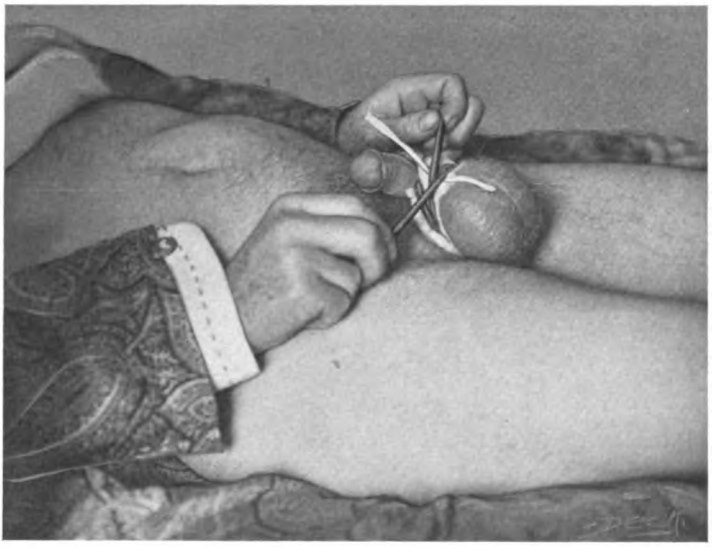


Fig. 10.—Obstructive hyperemia for the testicles. The ends of the elastic tube are held by the patient, crossed. A piece of tape is placed beneath to be tied by an attendant.

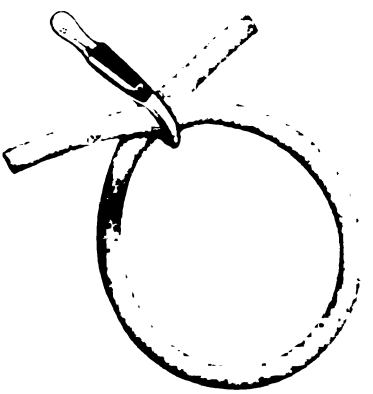


Fig. 11.—Rubber tube for the hyperemic treatment of the testicles; ends crossed and clamped to the side of the penis.

to make the lip anemic (Fig. 11); or they are crossed and then held in place by a piece of tape or silk thread, in the same way as we tie a tube around the inguinal fold of the thigh and abdomen in order to produce Esmarch's artificial anemia for the high amputation of the thigh. (Fig.

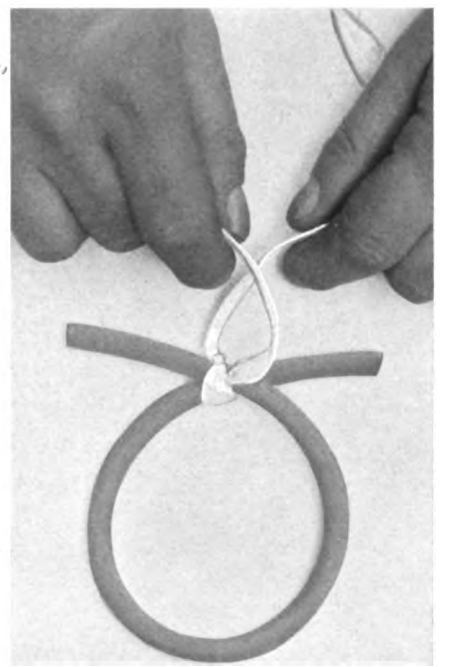


Fig. 12.—Rubber tube for the hyperemic treatment of the testicles; ends crossed and tied. This, of course, can be done only by an attendant, except the tubes are clamped at the crossing and the clamp is removed the moment the knot is tied, being pushed off with the finger.

12.) The proper degree of hyperemia can thus be regulated in a very simple manner. Of course, the effect of the obstruction, the venous hyperemia of the testicles, cannot be seen; the skin of the scrotum with its engorged

veins represents the indicator for the proper degree of the hyperemia.

Patients learn quickly to apply the band themselves. However, they must always remain under strict medical supervision.

If help is at hand, it is advisable for the patient to lie down and pull the diseased testicle or better both testicles strongly upward, so as to form a kind of a scrotal pedicle near the base of the pars pendula penis. This pedicle is then surrounded two or three times with the tube, the ends being knotted, tied or clamped. (Fig. 10.)

2. OBSTRUCTIVE HYPEREMIA BY MEANS OF SUCTION APPARATUS.

Suction Apparatus.

For some years Bier has been employing suction apparatus (also called vacuum apparatus, suction cups, cupping glasses) for the induction of artificial hyperemia. The method has been more carefully developed, however, by R. Klapp, who has been connected with Bier's clinic as assistant for many years. And now this kind of technique has been adopted in clinics and hospitals the world over. Suction cups properly constructed and applied have proved to be a most efficient means of producing obstructive hyperemia.

Effect.

By applying suction hyperemia it will be seen that the skin plus underlying tissues are sucked into the hollow of the glass. This causes a rush of blood into the respective area, but the hyperemia does not involve the surface only; it also reaches into the deeper layers.

Hyperemia produced in this way is similar to that resulting from the application of the elastic bandage.

Here, again, the first rule is *not to overdo. The skin should turn red or bluish-red, but never white.* Any interruption of the circulation as demonstrated by anemia must be strictly avoided.

Technique.

To be able to employ the method more generally, it was necessary to have cupping glasses, the shapes of which were adapted to the varying contours of the body surface. To meet this requirement glasses are now to be had in manifold sizes and shapes, with smooth and U-shaped brims, the latter for application to round surfaces, without exerting undue pressure. To reduce the pressure to a minimum, the brim is thickened and in some cases turned outward.

In the small-sized glasses suction is obtained by a small rubber bulb which is either directly attached to the glass (Figs. 13–16) or communicates with it by means of a rubber tube. (Figs. 17–20.)*

With gentle pressure on the rubber bulb the cup is put in place and the hand is removed The cup will be found to adhere to the skin with just sufficient firmness not to drop off. To facilitate air-tight closure of the cup upon the skin, it is well to spread a thick layer of vaselin over the border. Here also, a "too-much" must be strictly guarded against. *Suction must never be too strong and never create pain.*

The vacuum apparatus of larger size are applied with a suction pump (Figs. 21 and 22), which is inserted into the end of the rubber tube in place of the bulb and regulates the degree of hyperemia.

* The New York depot of all suction glasses and apparatus, pertaining to Bier's hyperemic treatment, is The Kny-Scheerer Co., 289 Ninth Avenue.

In all of the large-sized suction glasses and some of the smaller ones a three-way stop-cock is placed in the tubing for the purpose of obtaining air-tight closure of the cup after the desired degree of obstructive hyperemia

Fig. 13. Fig. 15. Fig. 14.

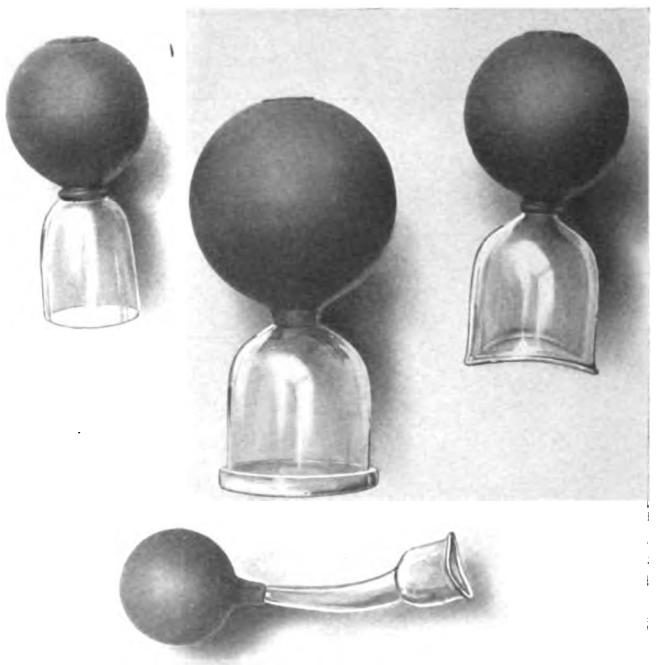


Fig. 16.

Figs. 13 to 16.—These cups represent the simplest form of suction glasses. One recognizes the various shapes and sizes, the thickened, turned-up border; in some the latter is curved U-shaped. The rubber bulb is attached directly to the glasses. These glasses are used in the treatment of furuncles of smaller size and sinuses.

has been attained, as also to facilitate their removal, which is of value especially in connection with the very large cups, that cover the entire female breast. (Figs. 23 and 24.)

In making use of these vacuum apparatus we not only rely on the artificial hyperemia they produce, but also, and by no means least, on their mechanical effect. **Mechanical Effect.**

If we place such a glass over a diseased area which

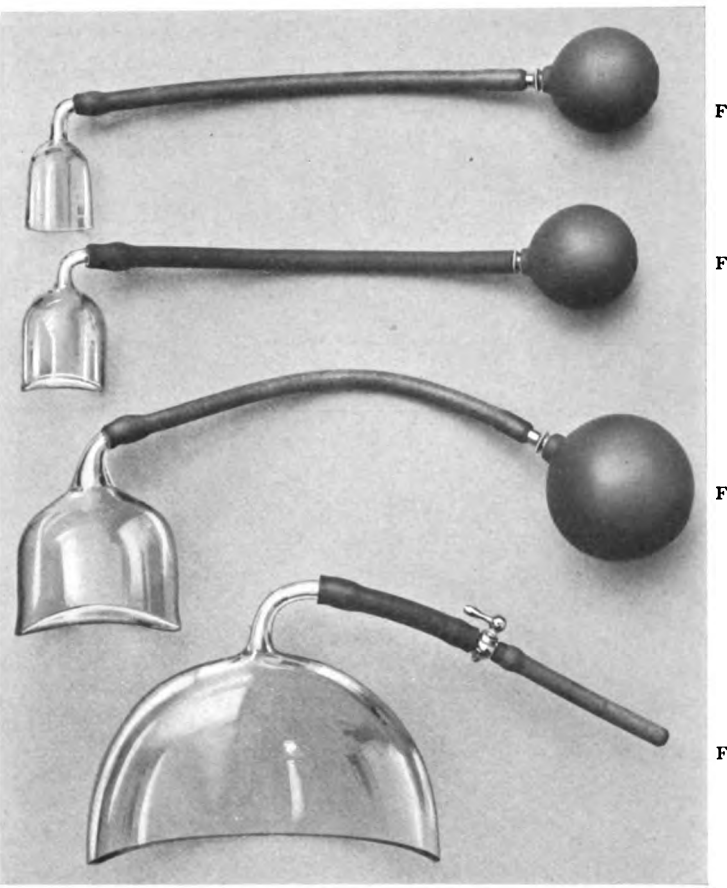


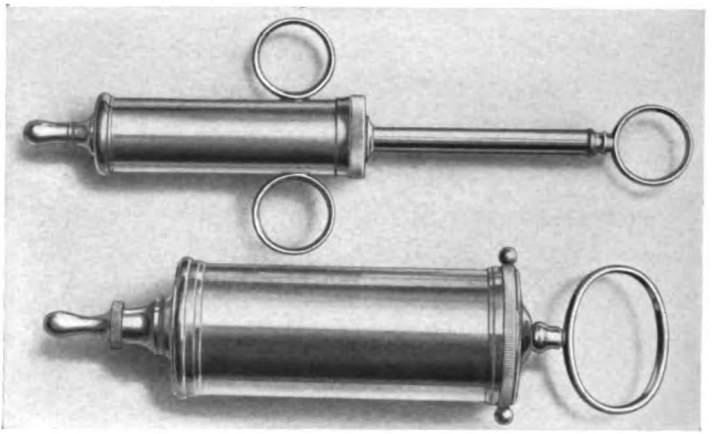
Fig. 17.

Fig. 18.

Fig. 19.

Fig. 20.

Figs. 17 to 20.—Show glasses of simpler configuration; a rubber tube connects glass with bulb; the same can be readily detached, thus rendering easy the sterilization of the glass by boiling. In the tube of Fig. 20 a three-way stop-cock is inserted. These cups are used for treating furuncles of larger dimensions, etc.



Figs. 21 and 22.—These figures show suction pumps of various caliber designed for the production of the proper vacuum in apparatus of larger size; the smaller pump can be worked with one hand.

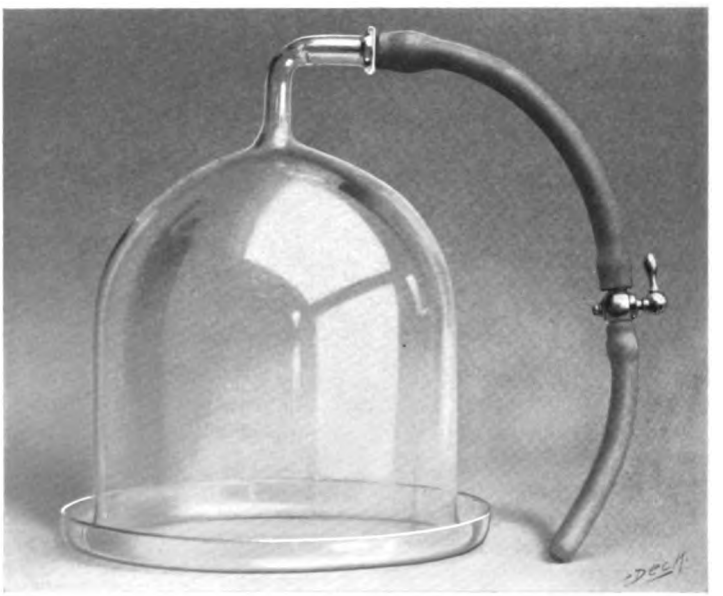


Fig. 23.—Suction glass for puerperal mastitis.

presents a sinus in its middle, the pus and with it bacteria are aspirated from the depth, slowly and painlessly; often necrotic tissue, or even sequestra of small size, are brought to the surface. This suction effect is particularly valuable, for the granulations lining the fistulous tract or the abscess cavity are in this manner also brought under hyperemia,

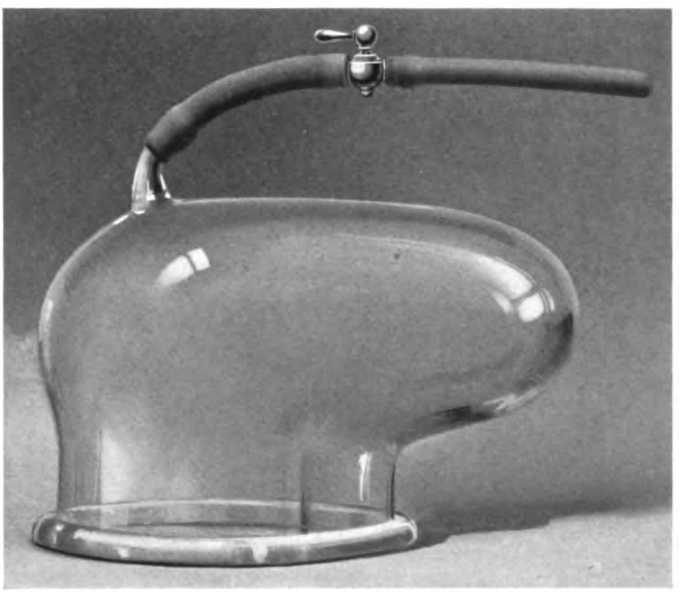


Fig. 24.—Suction glass for puerperal mastitis; the projecting part to the right will collect the wound secretions, and, naturally, is made the lowermost part of the glass, when in place.

and the current of secretion, thus directed outwardly, bathes and cleanses them gently but thoroughly.

Disinfection.

In thus using the suction glasses in the treatment of suppurating wounds and fistulous tracts, strict asepsis is, of course, a *sine qua non*. After using, the glasses must be detached and boiled. If kept in a sterilized

towel or gauze, or, if preferred, in a solution of bichlorid after boiling, the glasses will be always ready for use. If proper care is taken to prevent soiling the rubber parts,

Fig. 25.

Fig. 26.

Fig. 27.

Fig. 28.

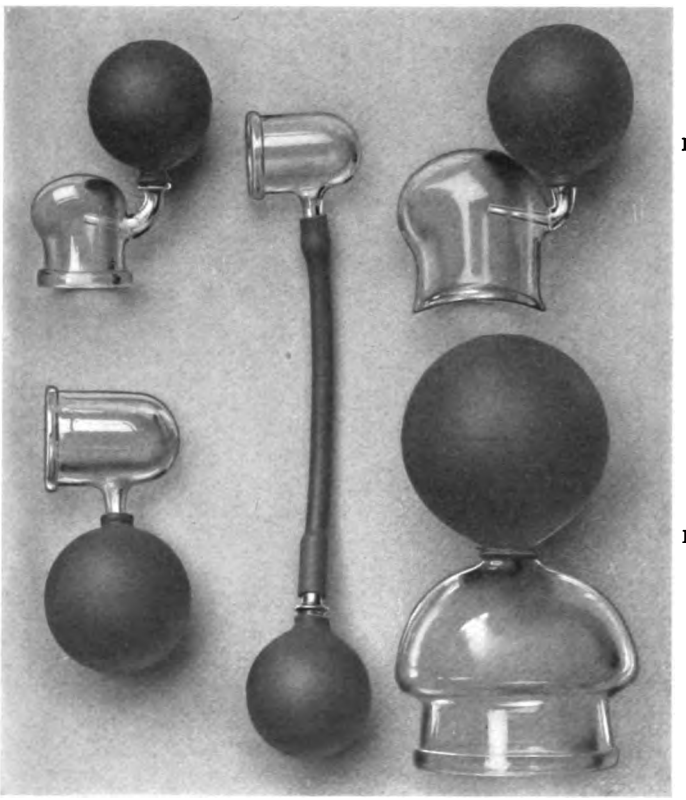


Fig. 29.

Figs. 25 to 29.—These figures represent vacuum glasses shaped especially for the collection of wound secretions, rendering it impossible for the latter to enter or come in contact with the rubber parts.

these need be boiled only now and then and, consequently, will last longer.

In order to better avoid such contamination by pus and

wound secretion special glasses are made with a receptacle at their lower end. (Figs. 25 to 32.)

Infection from the aspirated pus may further be avoided by anointing with vaselin the border of the glass as also the immediate neighborhood of the wound. This precaution is especially indicated when treating furuncles.

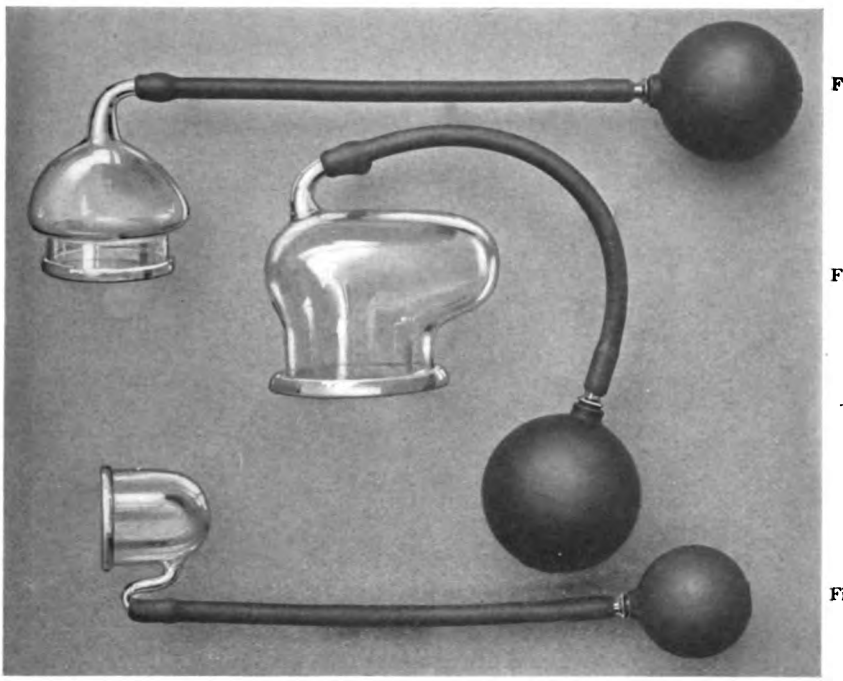


Fig. 30.

Fig. 32.

Fig. 31.

Figs. 30 to 32 show other shapes with a special receptacle for the pus. Here, too, the pus cannot be aspirated into the rubber tube.

After the cupping, the skin is cleansed with a piece of gauze or cotton soaked in ether, and a dry or moist gauze- or an ointment dressing is applied.

In one of the previous chapters dealing with the treat- **Abscesses.**

ment of infective processes by means of the elastic bandage, it has been stated that pus must be evacuated as soon as found. The same rule holds good in the treatment with suction cups. It would be senseless to apply suction hyperemia over an abscess without first opening the same. What should be done, after careful preparation and anesthetization of the skin, is to puncture the abscess and then apply a cup of proper size.

At the first application a good deal of blood will be found mixed with the aspirated pus, but this is of no consequence, and will not continue.

Duration of Application.

The suction glasses are applied six times five minutes per day with intervals of three minutes between the applications in order to give the edema and hyperemic swelling an opportunity to disappear. Thus the entire time of treatment is three-quarters of an hour each day.

Of course, it is not necessary to religiously adhere to this proportion of time. Slight deviations will not matter. The five to three minutes rule, which experience has shown to be followed by good results, has been given merely as a guide.

This manner of treatment has yielded most gratifying results. A very pronounced degree of hyperemia can thereby be obtained in almost any portion of the body surface, and, as shown in Part II of the book, serious and painful operations may thus often become unnecessary.

The use of the suction cups, too, can be learned by the patients and, after some practice, may be entrusted to them, should this become necessary. However, as a rule, the attending physician should be in permanent control of the treatment. (Fig. 33.)

The surgeon, specialist and general practitioner who may find a wide range of application for these suction cups would best set aside a room, next or near to the office, in which patients requiring the suction treatment may be attended to.

The same holds good of hospitals and particularly dispensaries in the large cities. They should not only have a separate room,—or at least part of a room,—but a

Fig. 33.—This illustration shows a group of patients of the Surgical Poliklinik of the University of Berlin treated with various suction cups for suppuration and fistulous tuberculosis.

specially trained assistant and nurses, to take charge of such department.

Dressings when Suction Cups are Used.

As has been stated before, pus and other wound secretions are aspirated from sinuses by means of the cups. This is not only of great practical value, but also of benefit to our patients, in that the painful tamponades of wounds with gauze as well as their drainage by means of rubber tubing can usually be dispensed with.

Thus the painful tamponade of felons, furuncles and the wounds resulting from multiple incision of the inflamed breast in puerperal mastitis, etc., has become obsolete and superfluous.

Suction Apparatus of Large Size.

After the suction glasses of small size had been practically tested as to their value, the manufacture of stronger,

Fig. 34.—Illustrating an ordinary suction apparatus for the finger (felon, etc.) with a convexity at the lower surface, designed to receive the pus.

bottle-shaped vessels suitable for the reception of the entire extremities was taken up. The limb is pushed into these vessels through an aperture at one end. A rubber cuff is fitted snugly around the rim. It may be necessary sometimes to apply a rubber bandage in order to secure air-tight closure. Then the air is aspirated and the stop-

cock fastened. A very pronounced red hyperemia will soon ensue. A little later small drops of water due to the evaporation of the perspiration collect on the inside of the apparatus.

This form of hyperemia can be employed for various therapeutic purposes. The degree of suction required in the given case can be readily regulated.

Again it should be stated that here, too, great care must be exercised not to overdo. *The application should be absolutely painless. It should never interrupt circulation,* but merely produce a moderate degree of congestion.

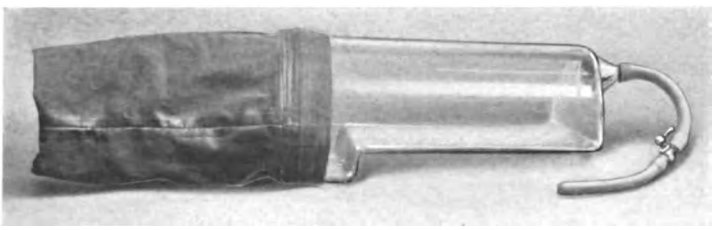


Fig. 35.—Constructed for the treatment of the hand. A soft rubber band wound around the cuff makes it fit air-tight around the arm.

A few simple specimens of these larger cups are shown in Figs. 34 and 35. The smaller one, designed for the fingers, is connected with a rubber bulb; the larger one, intended to receive the whole hand, is worked by a suction pump. For the rarefaction of the air in the very large apparatus, a correspondingly large suction pump is used, not unlike the kind used by bicyclists. By placing the valve differently, a pressure pump is converted into a suction pump.

The Utility of these Apparatus for Mobilizing Stiffened Joints.

The hand or foot or extremity placed within one of these apparatus is forcibly drawn forward until it meets an obstacle in the lower end-wall of the glass, after which it turns in the direction of least resistance.

This mechanical effect can be utilized to advantage for

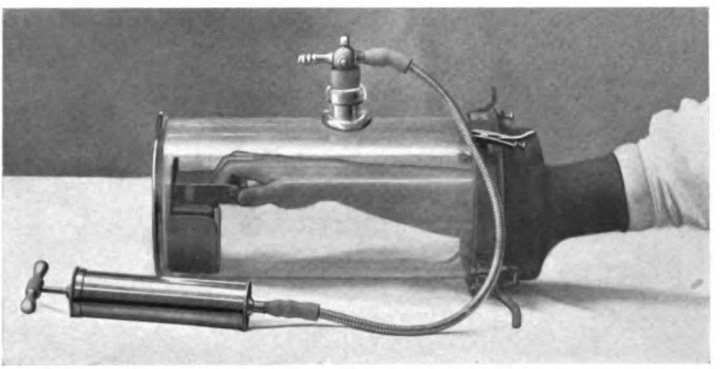


Fig. 36.—Medium position for moving the wrist in the vacuum glass. The illustration shows a large suction glass for the entire forearm. The cuff clings firmly to the arm so as to shut off all air. The fingers and hand are flexed or stretched with the same force as the arm is pulled into the apparatus and are pressed against its lower end. (Figs. 36 to 45, inclusive, demonstrate the uses of the suction apparatus for orthopedic purposes. The hyperemia and edema produced incidentally will reduce the accompanying pain to a minimum.)

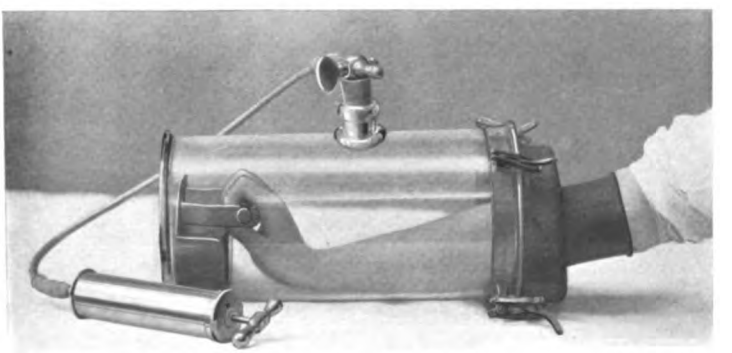


Fig. 37.—The illustration shows how dorsal flexion of the wrist is produced by the vacuum.

orthopedic purposes; viz., for passive motions of stiffened

joints, pads or a rubber pillow or handles being placed within the apparatus to support and guide the extremity in the

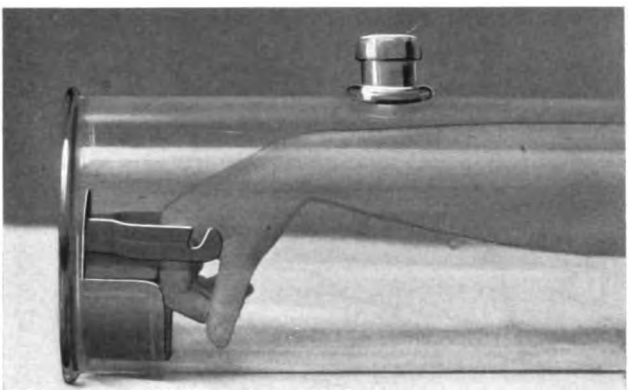


Fig. 38.—By pressing the knuckles against the upper part of the support, volar flexion of the hand is started.

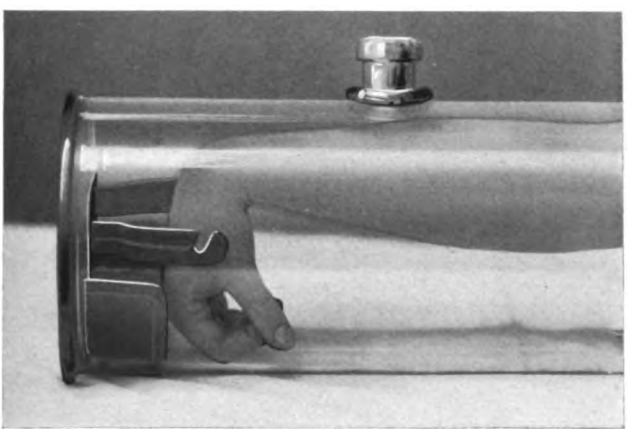


Fig. 39.—Strongest volar flexion; the dorsum of the hand touches the support.

desired direction. The accompanying figures nicely illustrate the idea. (Figs. 36 to 52.)

The principal point in favor of this new method is its gentleness of application. Stiffened joints are in this way

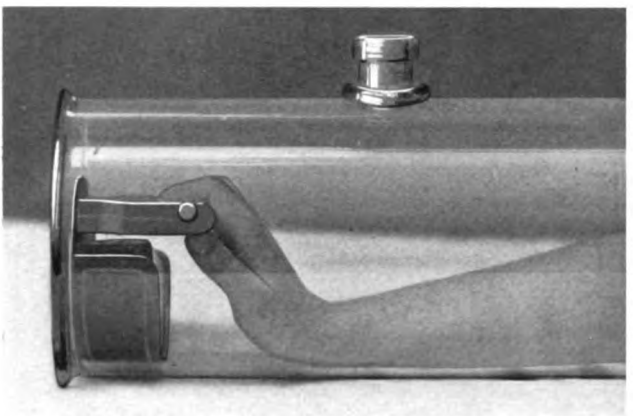


Fig. 40.—Illustrates the passive stretching of the fingers.

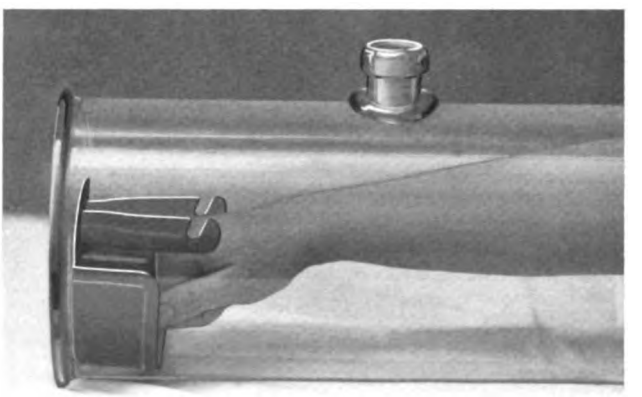


Fig. 41.—Shows how the fingers are gently but irresistibly pressed into flexion by the vacuum.

mobilized with much less pain than could be done with orthopedic apparatus for passive motions.

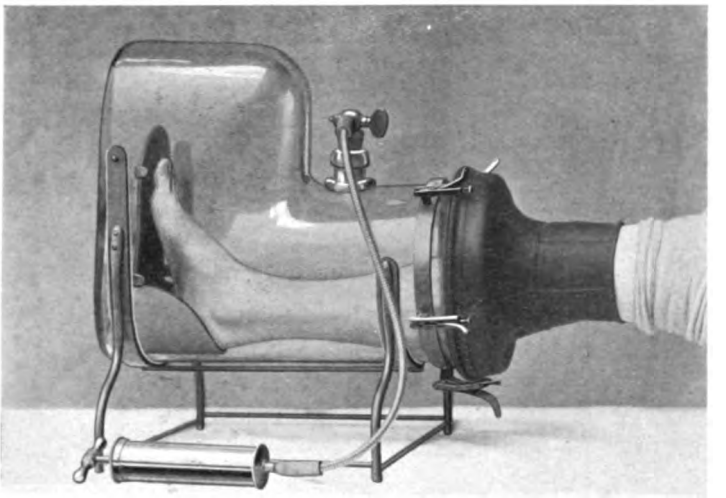


Fig. 42.—The foot-piece in place without supports. (Figs. 43 to 45 demonstrate the various angles into which the foot may be forced by means of correspondingly shaped supports.)

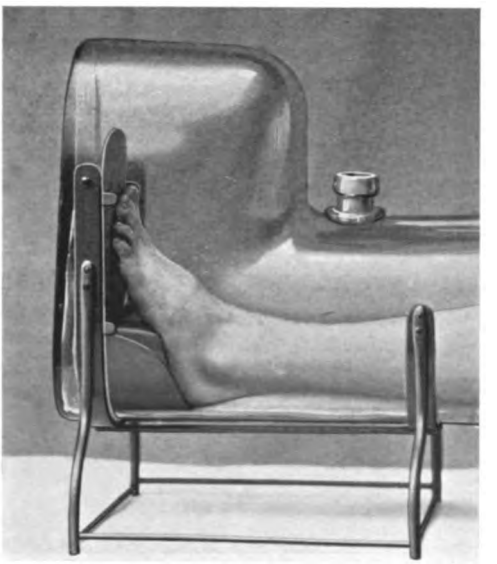


Fig. 43.—Small cushion placed under the heel for the treatment of talipes calcaneus.

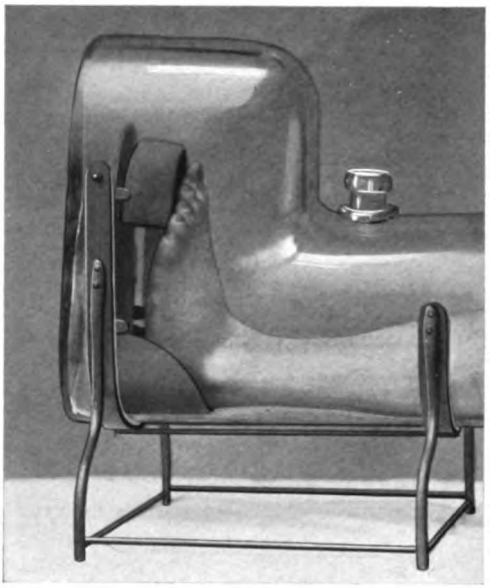


Fig. 44.—Small cushion under the fore part of the foot for the treatment of pes equinus.

Fig. 45.—Large laterally slanting cushion in place; the higher edge supports the inner side of the foot to obtain supination.

This is due mainly to the fact that, incidentally, a marked hyperemia is produced in the respective joint, the consecu-

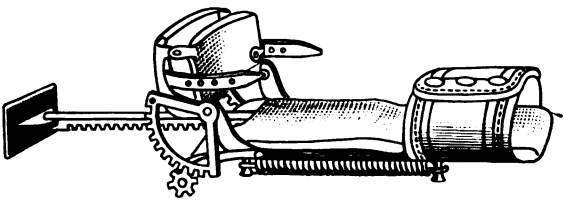


Fig. 46.—Example of apparatus for finger-stretching with rack and pinion; it is introduced into a glass cup. Various other styles are in the market and still others can be easily designed.

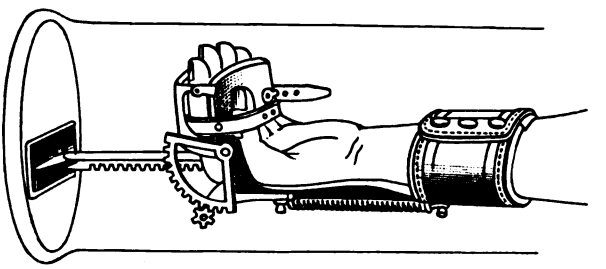


Fig. 47.—Showing position of the hand, strapped, when the auxiliary apparatus as illustrated in Fig. 46, has been introduced into the suction glass.

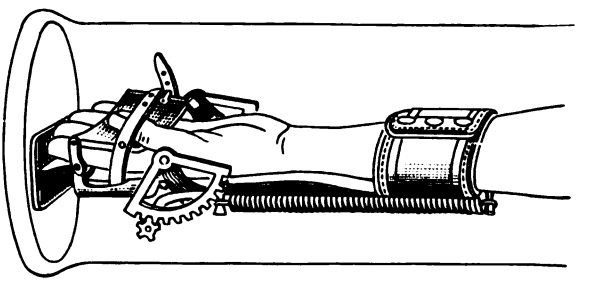


Fig. 48.—The fingers successfully stretched. The hand with forearm aspirated toward the bottom of the glass. The incidentally produced hyperemia of the part of the extremity within the glass reduces the accompanying pains very materially.

tive vascularity and serous infiltration of the parts rendering them limber.

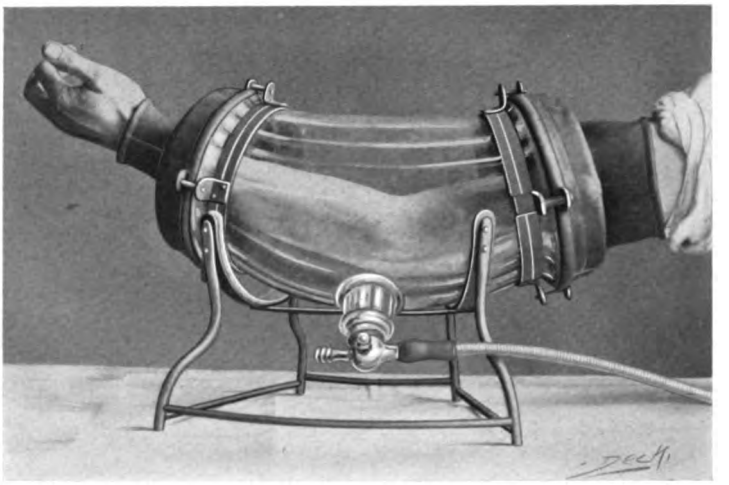


Fig. 49.—Suction apparatus for the elbow-joint. The illustration shows how the elbow, which when introduced was entirely extended, has been bent slightly by the suction process. In consequence of the edema and hyperemia produced, the accompanying pain is very slight, same as in all other cases in which the glasses are used.

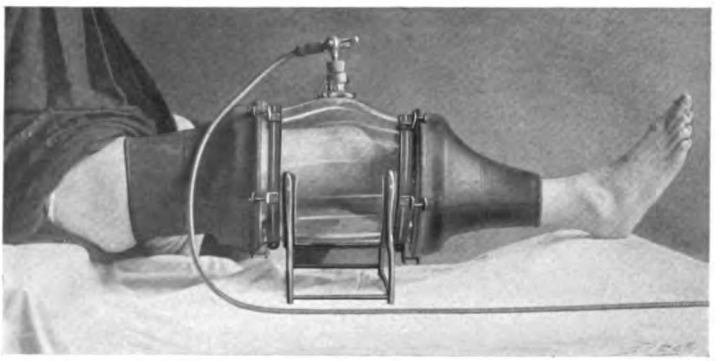


Fig. 50.—Suction apparatus for the knee-joint, to produce flexion. The rubber cuffs close air-tight; the one around the thigh making obstructive hyperemia of the parts below at the same time. By rarefying the air in the apparatus with a large suction pump the knee-joint, which is stiff in full extension, is made hyperemic with part of thigh and leg and gently forced into flexion. The procedure is not accompanied with any appreciable pain.

These suction apparatus, too, are used intermittently. A strong hyperemia is arranged for, but not sufficiently

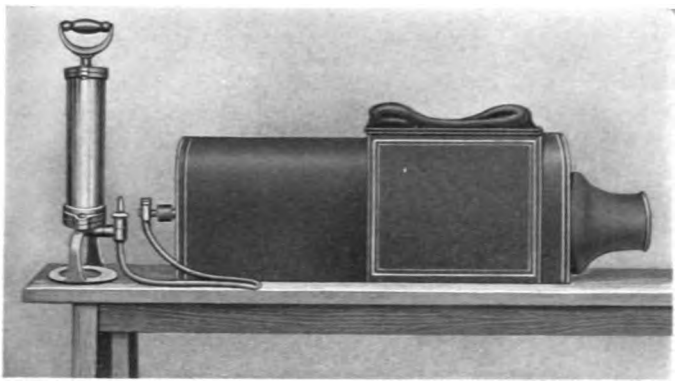


Fig. 51.—Suction apparatus for knee-stretching.

so to cause pain. It is continued for five minutes. Then, by turning the stop-cock, air is admitted. After two to

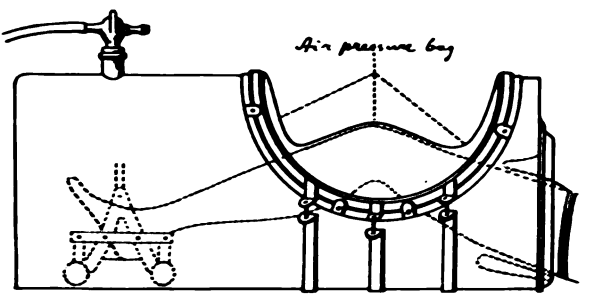


Fig. 52.—Illustrates in a diagrammatic sketch how a contracted knee can be gradually and almost painlessly stretched by means of the suction apparatus shown in Fig. 51. The elastic air-pressure bag which fills the cut-out of the apparatus forces the knee downward with atmospheric pressure, whilst the foot rests and slides forward on the little wheel-cart.

three minutes the procedure is repeated, until one-half to three-fourths of an hour has passed.

Of course, all these appliances in order to give full satisfaction, should be handled by thoroughly trained persons only, and then under strict medical supervision.

The suction apparatus just described, in which the mechanical forces are utilized for orthopedic purposes, are but types of a group of similar ones designed by Klapp.

With the help of special apparatus most of the large joints of our body can be made to profit by this treatment.

It is not our desire to go into further details here. Those interested may study the respective publications that have appeared in medical literature.

3. THE INDUCTION OF HYPEREMIA BY MEANS OF HOT AIR.

Hyperemia by Means of Hot Air.

It has been shown that it is possible to produce a pronounced hyperemia by means of hot air of any kind.

Any part of our body, brought near a source emitting strong heat, becomes heated and turns bright red, or hyperemic. However, the hyperemia produced in this way is different from that induced by obstruction. The latter causes a *venous* hyperemia; the hot-air hyperemia represents an *arterial* one.

Heat for the production of hyperemia has been employed as long as the art of healing exists. The laity, likewise, has used it in the shape of hot baths, hot fomentations, hot poultices, sun-baths, hot-sand baths, etc., which find their sequelæ at the present time, in electric-light-baths, steam-baths, etc.

The effect, too, of hot-air hyperemia is different from that of obstructive hyperemia, not only as regards the body but also as to pathologic processes.

For this reason, hyperemia brought on by hot air has its own special indications.

The increased supply of arterial blood to any part of the body favors absorption of chronic exudates, infiltrations, adhesions, etc. Therefore, these *chronic conditions*, being the result of a previous acute inflammation, are particularly favorably influenced by hot-air hyperemia.

The second class of cases that can be advantageously treated by means of hot-air hyperemia are neuralgias of all varieties.

With reference to indications for this treatment details will be found in the second part of the book.

Bier, who was the first also to make use of hot-air for the induction of hyperemia, has made a very careful study of it for many years, and has been impressed with its manifold advantages as compared to other methods.

Dry, hot air permits of the use of a very high degree of heat, without injury or pain to the respective part.

Dry hot air finds practical application in surgery in two ways:

1. By means of the hot-air boxes or chambers.
2. By way of the hot-air douche.

Hot-air Boxes.

The most useful hot-air boxes are quadrangular *wooden* chambers of simple and inexpensive construction. Any carpenter can make them. The one thing to be observed is that the wood is well seasoned and free from resin (alder, poplar), as the latter would become liquid from the heat and might drip down upon the exposed parts. The boxes (Figs. 53 to 60) are provided with a lid which, according to necessity, shows one or two openings for the reception of the limb (arm or leg). These

openings are lined with cuffs of some insulating material (broad flaps of felt), which are fastened around the

Fig. 53.—Shows the wooden hot-air box for the hand. Note the manner in which the felt cuff is made to fit air-tight by straps. A thermometer is placed in one of the apertures in the top, although this is usually unnecessary, the patient's own feeling being the best index to the proper degree of heat.

limb by means of straps and buckles. Of course, the cuff must never be applied so tight as to impede circu-

lation. On one side of the chamber is found an attachment for the reception of the chimney of the lamp, through which the current of hot air enters. For the purpose of a more even distribution of the hot-air

Fig. 54.—Shows the hot-air box for the elbow.

current and the better protection of the limb, a board is placed inside the box not far from the internal aspect of the opening. For the same reason the chamber must not be of too small size. The larger it is in proper propor-

tion to the circumference of the limb the more evenly distributed will be the hot-air current. The lid contains one or two additional openings for the escape of air, which should be in constant motion. This ventilation makes

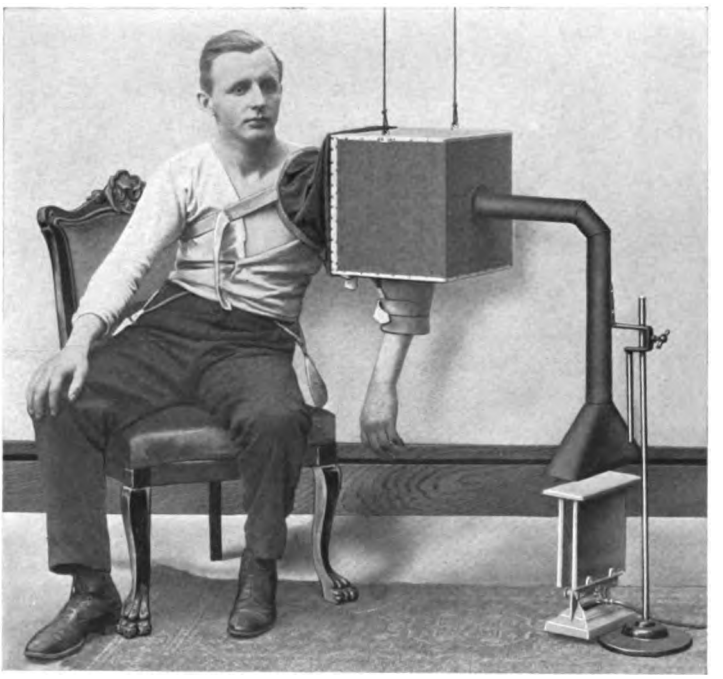


Fig. 55.—Shows the hot-air box for the shoulder; apparatus is suspended from the ceiling, an arrangement which enables the surgeon to use the same apparatus for either side. This is easily done by reversing the chair. This arrangement will be found especially useful in dispensaries, or in the offices of physicians who practise in places where institutes for hot-air treatment are not at their disposal.

the air dry and allows the perspiration to evaporate. It is a well-known fact that high degrees of hot air are much better borne in a dry than in a moist atmosphere.

The beginner may introduce a thermometer through one

of the holes in the lid, which will show him the degree of heat within the chamber. But the patient's own feeling ought to be the best guide for the proper temperature. *There must be no pain nor even annoyance from the heat.*

If the temperature is gradually increased, a surprisingly high degree of heat can be borne by the patient. Often

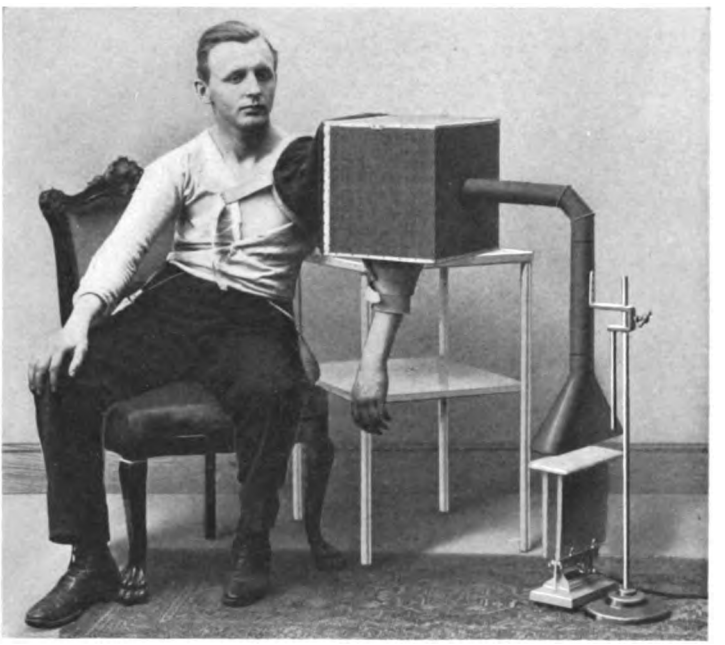


Fig. 56.—The same, with the box placed on a small table.

the thermometer registers as high as 250° to 260° F. (120° to 125° C.) and more, at least in the upper part of the chamber.

In this connection it must be borne in mind that great heat makes the parts less sensitive. *If due care is not taken a burn of the second degree may occur*, without the

Burns.

patient's being aware of it, until after the sitting, when he will find a blister.

To make the chambers more durable, they are covered with cloth. The inner surface is soaked in silicate, thus reducing the danger of fire.

As already stated, the hot air is carried into the box

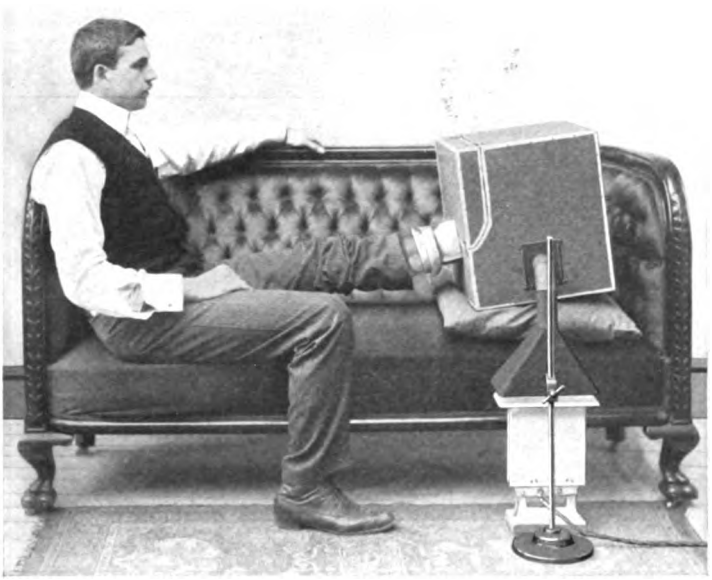


Fig. 57.—Shows the hot-air chamber for the foot; an electric stove supplies the heat. Of course, the patient who can leave his bed could as well sit on a chair with the box placed on another chair. If the patient is confined to bed, the box may be placed in the latter.

through a small funnel-shaped sheet-iron chimney which is curved at its upper end to meet the hole in the side of the chamber. An alcohol or gas lamp placed on a stand underneath the funnel supplies the heat.

The regulation of the heat is effected by the size of the

flame, as also by raising or lowering the lamp on its stand. The lower the lamp the less heat it furnishes.

When heating with gas, care must be taken never to have any gas enter the box which might become the cause of an explosion. *The lamp should be lighted before it is placed under the funnel.*

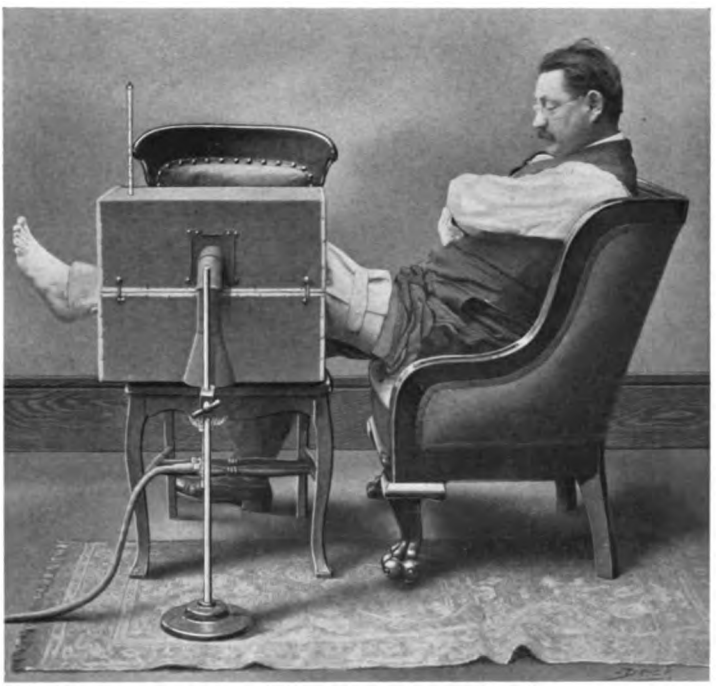


Fig. 58.—Shows the hot-air chamber for the knee; a gas lamp is the source of heat.

A glance at the cuts will demonstrate how the patient should be placed. He should be in as comfortable a position as possible during the treatment.

It has to be mentioned that tips of toes and fingers do not stand very great heat. This is due partly to the

presence here of the large number of nerves, partly—in the case of the toes at least—to the fact that they reach into the upper portion of the chamber in which the thermometer always shows a higher temperature. To prevent injury, these parts are either wrapped in asbestos, or the chamber for the foot is fitted with a toe-protector.

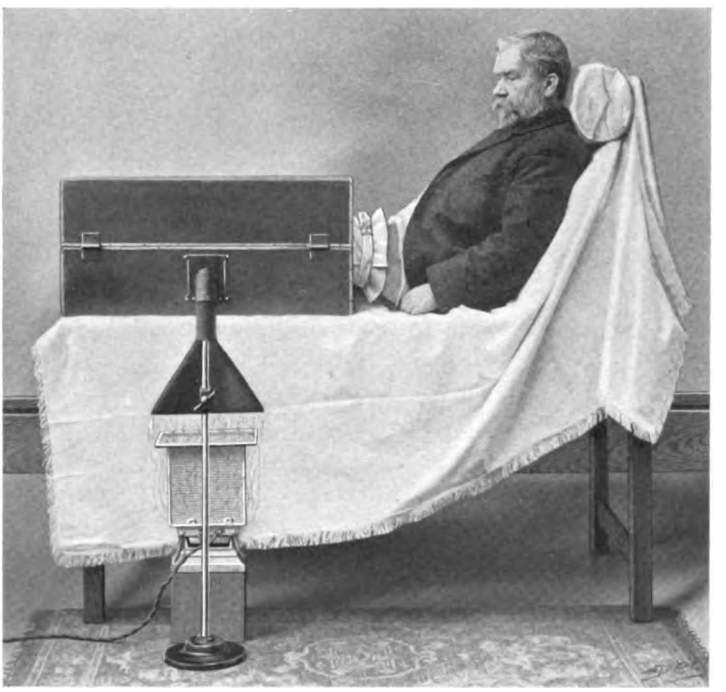


Fig. 59.—Shows the hot-air chamber for the whole leg. Here again the source of heat is an electric stove, an arrangement which simplifies matters considerably.

The illustrations show nicely how the various joints are treated.

First the extremity is comfortably placed in the box and the lid closed. Then the lamp is lighted and placed

underneath the funnel. When a comfortable degree of heat has been obtained, it must be the operator's aim to continue the same temperature. After one-half to one hour the light is extinguished, and a few minutes later the lid of the box opened. It is detrimental to have the temperature change abruptly. A pronounced hyperemia of the part will be noticed. Usually profuse perspiration has set in, which should be carefully wiped off.

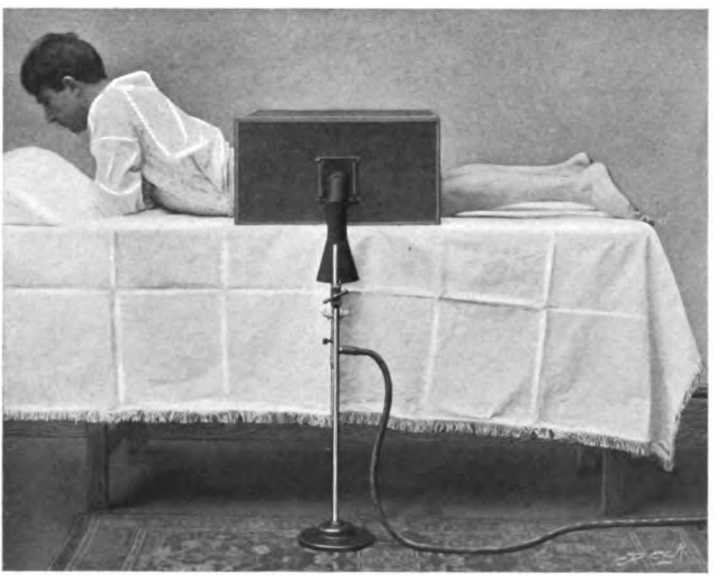


Fig. 60.—Shows the hot-air chamber for both hips.

If the patient's condition makes it seem wise, the treatment may be given every other day instead of daily, and for a shorter period, at least in the beginning.

The chamber for the shoulder needs a few special words of explanation. As will be seen from the illustration, the arm is introduced into the box through a sleeve-like

attachment; the hand is pushed out again through an aperture in the bottom. The apparatus is hung up against

Fig. 61.—Shows the hot-air douche applied for trigeminal neuralgia. The patient himself directs the nozzle, bringing it as close to the affected area as he can stand it. He should keep his eyes shut. Application, about one-half hour daily. If possible, massage should immediately follow the procedure.

or attached to the wall of the room by means of rings.

It can thus be easily turned around, so that one and the same box may be utilized for right and left side.

There have been placed upon the market so-called

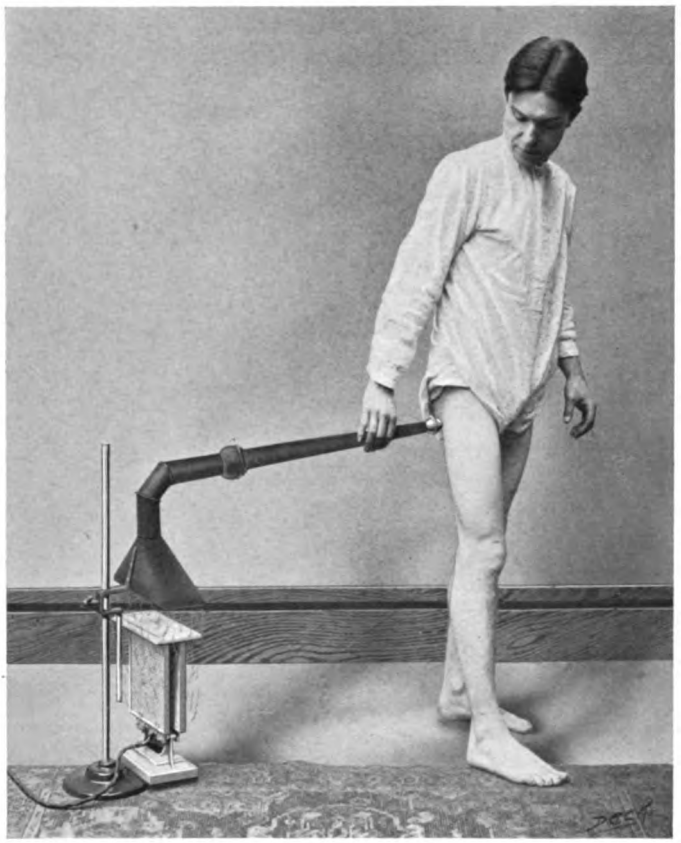


Fig. 62.—Shows the hot-air douche applied for sciatica. Here the heat is supplied by an electric stove. The patient again himself directs the tube toward the sensitive area, spraying, as it were, the surface of the body with hot air. The distance of the tube from the skin regulates the temperature. The douche should be taken as hot as the patient will tolerate.

"Universal Boxes," to be used for a number of different joints. They are not recommended.

Hot-air Douches.

For the hot-air douches the chimney of the hot-air box is utilized. It is fitted with a pipe about 30 inches (75 cm.) long, which moves in a hollow ball joint. (See Figs. 61 and 62.)

If the douche is used in the neighborhood of the eyes, the latter must, of course, be kept shut.

The sittings are for one-half hour daily. If possible, the application should be immediately followed by massage. The degree of heat is lowered as the improvement progresses.

Electricity also may be employed for heating the air in these apparatus, thus doing away with the products of combustion of alcohol and gas. While the appliances arranged for the use of electricity are simpler to handle, they are more costly. It certainly would seem advisable to buy one of the less expensive apparatus first.

Patients with often recurring attacks of rheumatism or neuralgia can use the hot-air boxes or douche at their homes under the direction of a physician.

SPECIAL PART.

THE TREATMENT OF SPECIAL DISEASES BY MEANS OF ARTIFICIAL HYPEREMIA.

In now turning to the discussion of the treatment of various diseases with the help of Bier's method, only such will be considered at length, regarding which sufficient experience has been collected to warrant us in recommending the use of the method.

There is no doubt that this range of application will widen as time goes on.

To enable the reader to readily distinguish between the diseases in which the method has already been thoroughly and successfully tried, clinically, and those in which it is still in an experimental stage, large type will be used for the former class of diseases, smaller for the latter.

Only facts are stated and suggestions added without mention of the names of the authors.

A bibliography on hyperemic treatment will be published by us in the near future.

CHAPTER IV.

HYPEREMIC TREATMENT IN SURGERY.

TRAUMATISMS.

Contusions and Distortions.

The powerful effect of the hot-air bath can be made use of to best advantage in bringing exudates of blood to more rapid absorption.

While the effusion of a small amount of blood into the soft parts, subcutaneous connective tissue, or between the muscles, usually takes care of itself, more profuse exudations, or cases in which rapid absorption is desirable for special reasons, are greatly benefited by hot-air applications of, say, one hour per day. Such treatment is superior to prolonged obstructive hyperemia plus massage or massage alone. It is easily applied and causes less discomfort to the patient.

In the frequent contusions of the fingers, especially of the third phalanx carrying the nail, immediate short gentle massage—just to overcome the first pain—followed by obstructive hyperemia with an elastic band around the base of the first phalanx, twice eleven hours per day, will stop the pain and facilitate, in conjunction with hot-air treatment, absorption of the uncosmetic subungual exudate. (See Fig. 63.)

In cases of severer injury to a joint, in which the blood quickly fills the synovial sac, it is of greatest importance that this blood be promptly and thoroughly absorbed, as

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otherwise fibrous union of the surfaces of the joint with pronounced stiffness may set in.

Traumatic Hydrops of the Knee.

An example of this class of cases is the acute traumatic synovitis of the knee, due to a "sprain" or "distortion," the so-called "traumatic hydrops" of the knee.

A correct diagnosis is of greatest importance in these

Fig. 63.—The illustration shows a small size elastic band (*a*) around base of forefinger, producing a degree of hyperemia which usually suffices for prophylactic work.

cases, especially with reference to a beginning joint tuberculosis (*tuberculous hydrops*).

Bier advocates aspiration of the affected joint in severe cases only; that is to say, cases in which the joint is very much swollen from the effusion of blood and synovial

fluid, or in chronic cases when the blood has been partly replaced by serum, and hyperemic treatment proves inefficient.

In ordinary cases a hot-air bath is advised. The patient is kept in bed during the first few days after the injury; then he may get up and gently exercise the joint, although it is well, in the beginning, to apply a slightly compressing flannel bandage.

If no improvement be noticeable within a reasonable time, aspiration will have to be resorted to.

It is not claimed that hyperemia will here crowd out of existence all other well-known, time-honored methods, such as elastic compression with or without previous aspiration, splints, Priessnitz dressings, etc. The hyperemic treatment is but another, though most valuable and powerful as well as gentle method in the treatment of this trouble, which will render superfluous in a certain proportion of cases aspiration and prolonged rest in bed.

Joint Fractures.

The painful swelling of a recent fracture involving the neighboring joint, with its inflammatory irritation, is readily controlled by this treatment. A typical Colles's fracture may serve as an example: After thorough reduction, the hand is fixed on a splint for eight to ten days. Then the latter is definitely removed and a hot-air bath lasting from one-half to three-fourths of an hour daily administered. Only in the event of very pronounced original deviation of the fragments is the splint applied during the interval. In the ordinary case there is no longer any tendency to a recurrence of the misplacement about one week after the injury. Soon after the removal of the splint active and passive exercises plus massage are added. This procedure shortens the time of healing and insures a useful limb.

Bier approves of immobilization of the joints only on strict indication. He is of the opinion that fixation splints favor the troublesome stiffening of the joints, which so often resists all and every mode of treatment.

Tenosynovitis.

The same holds good in cases of the crepitant form of inflammation which not infrequently develops within the extensor sheaths or between these and the muscles of the forearm after overexertion. Here the hand is not placed on a splint, not even in the beginning, the only treatment employed being a hot-air bath once a day.

Still better results are often obtained in the latter class of cases by obstructive hyperemia. The elastic bandage is applied for twenty to twenty-two hours per day with two intermissions of one to two hours each. So long as crepitation and pain persist no hard work should be undertaken.

While the symptoms would probably subside in simpler way and more speedily if a splint were applied in these cases, it has been observed that in that event the trouble is very apt to recur as soon as the patient resumes his former occupation. Without the use of a splint, the result is more permanent.

INFLAMMATIONS.

ACUTE INFECTIONS.*

FURUNCLES AND CARBUNCLES.

These represent a type of acute local infection and merit special discussion on account of their practical importance and frequency of occurrence.

* The various acute surgical infectious inflammations are arranged according to the degree of difficulty in the technique of hyperemic treatment and the amount of careful supervision required for carrying it out properly.

Bier's hyperemia is easy of application and offers special advantages over other methods of treatment in these cases.

Furuncles as well as carbuncles are best treated with suction cups, which may be applied in any stage of the trouble.

Technique. If a suction cup be placed over a furuncle, a red hyperemia will be easily produced. If the cup be of sufficient size to reach over to parts not involved by the inflammation, its application will cause no pain. *The suction must be of mild degree.* If the borders of the glass are well anointed with vaselin, they will adhere to the skin without difficulty, even though the air within be but slightly rarefied.

The treatment is given but once a day, for three-fourths of an hour. That is to say, the suction cup is applied six times during this period, with regular intermissions of two to three minutes.

If applied in the early stage of the trouble, this treatment will usually prevent suppuration. If, however, the yellow blister has already developed, the formation of a slough (core) can rarely be avoided. In that event the suction glass may be employed to advantage in hastening the process and materially reducing the concomitant pains.

It must be remembered in suppurative cases to always thoroughly anoint the surrounding skin with vaselin in order to guard against further infection by the staphylococcus pyogenes aureus. If a crust has formed over the hole owing to scanty secretion, this should be removed with a forceps before the cup is applied.

The hyperemic treatment of furuncles by means of suction glasses prevents the infectious process from extending into the deeper tissues.

If suppuration has already set in, the pus and central

slough are gently aspirated from the depth of the infected focus, after the yellow blister has been clipped off with a pair of curved scissors.

Incision.

In exceptional cases only will it be necessary to make an incision; but then only a very small one, just sufficiently large to establish an opening. The large and painful deep cross-cuts into the surrounding healthy tissues, or extirpation of the entire infected area, with its tedious and painful after-treatment by tamponade, need no longer be practised. Even furuncles of large size may thus be healed with a very small scar, no larger than the orifice through which the pus found its exit.

If patients do not care about the size of the scar, a somewhat longer incision followed by regular suction will often hasten the process of healing.

Dressings.

A loose ointment dressing is applied after suction.

Duration of Treatment.

The treatment should be continued until all infiltration has subsided.

Size of Cups.

It may be difficult at times to obtain cups of proper size and shape to cover a large infiltrating carbuncle; but we should not allow this to stand in the way of our employing this efficient and gentle treatment. With a little extra effort we shall usually succeed in getting what we need, and our patients will be grateful. (Fig. 64.)

Although the skin usually presents the picture of a sieve owing to the manifold small holes that give exit to the pus, a correct suction treatment will fully preserve the skin, just leaving a number of disseminated dot-like scars.

Naturally such a treatment will take several weeks, but usually no longer than the old method of radical operative procedure requires, until cicatrization has set in.

Multiple and generalized furunculosis has been successfully treated by means of suction hyperemia. Of course, the treatment takes a great deal of time, but the result amply compensates both doctor and patient.

General medicinal and hygienic régime should not be omitted in these cases.

While the busy practitioner may often find it next to

Fig. 64.—Illustrates the application of Klapp's suction cup in a patient afflicted with a carbuncle of the neck.

impossible to give the time required by this method, he would, nevertheless, better bear it in mind in the event of the question of the cosmetic effect coming up for discussion.

Lymphangitis with Furunculosis.

Not infrequently a furuncle of the extremity is complicated with lymphangitis and regional lymphadenitis.

In such cases it is advisable to treat the furuncle. Its improvement will beneficially influence the sequelæ, except the glands suppurate. (See p. 86.)

Lymphangitis of the lower extremity requires rest in bed.

The Treatment of Furuncles in Diabetics.

Experience has shown that furuncles occurring in diabetic patients may well be treated with suction hyperemia. In view of the greater tendency in these cases to pressure necrosis, special care is necessary to see that undue pressure of the glass is avoided.

Furuncle of Lip.

The furuncle occurring upon the lip deserves special mention. It is known that progressive infection of the lymphatic system and sepsis often follow in its trail. This danger must not be lost sight of when hyperemic treatment is decided upon, and the surgeon who does not thoroughly master the technique of the method would better at once resort to the knife. On the other hand, those who have acquired the necessary experience with the method may well employ suction hyperemia even in these dangerous cases, and thereby save their patients the ugly, disfiguring scars resulting from radical treatment. Only small incisions are made in order to give exit to the pus as soon as it has formed, and the patient must be kept under closest observation. Much experience and tact are needed to successfully work on this borderland, to be able to judge when operative intervention is indicated.

Of course, if patients do not mind the resulting scars, an early proper incision remains the simplest road to recovery.

Even if there should be fatal results from hyperemic treatment of these cases, it is but fair to remind the pro-

fession that not all patients, promptly operated upon with the knife, recover.

In neglected cases immediate operation alone should come into consideration.

Technique. As to the technique, it should be stated that upon face and lip cups of small size with slightly U-shaped border should be used, and gentle hyperemia only applied. A strong suction is a technical mistake; it is never of benefit, and often produces extravasation of blood under the cup, followed by ugly, pigmented spots persisting for many days.

Obstructive Hyperemia by means of the Neck-band. For furuncles of the face and neck, obstructive hyperemia around the neck is also beneficial. Rules for its use have been laid down above. It is applied for fifteen to twenty hours per day, with various intermissions, and calls forth a pronounced edematous swelling of the face, particularly in the loose connective tissue of the eyelids. The reaction resulting from this artificial hyperemia is more marked in acute cases.

Best results are obtained from the treatment if applied early. Patients subject to frequent attacks of this trouble should, therefore, be instructed to consult their physician just as soon as the first symptoms become evident.

Abscesses, Acute Lymphadenitis, Infected Wounds. Acute Infectious Inflammations Within the Mouth and of the Face.

Abscesses. The treatment of abscesses, as also of the other affections mentioned under the above heading, does not differ much from that of furuncles and carbuncles.

The physician who has learned to handle the suction glasses in the latter cases will, naturally, want to make use of the same in other local inflammations.

The rules are the same: Every abscess should be promptly incised.

The small but troublesome abscesses found in the axilla, as a result of suppuration of the sudoriferous glands, yield to this treatment in a most gratifying manner.

Acute Lymphadenitis.

With proper care and technique, suction hyperemia will cure many of these cases. It seems well worth while to give the time and attention required by the hyperemic treatment also in these cases. It certainly is of importance if, in case of a localized infection, a group of glands in the axilla or groin can be preserved. Extirpation is not always a minor intervention; besides it deprives the body of this part of its protective system,—for the glands act as sieves for the infectious micro-organisms carried to them by the lymphatics.

In female patients the cosmetic effect of avoiding a scar of some length in the face or in the submaxillary region or on the neck is often of great importance.

It, furthermore, should not be forgotten that wounds, following operations for acute or subacute lymphadenitis in the groin (bubo), are often very slow in healing. The time of such detention of these patients in the wards of our hospitals can often be materially shortened by a correctly and faithfully conducted hyperemic suction treatment.

Infected Wounds.

In infected wounds the aspiration of the secretions with suction glasses has shown excellent results; *e. g.*, in case of a superficial or deep stitch-hole abscess following an aseptic operation, no better means for the rapid and thorough cleansing of such a wound are available than the suction cups. Often the secretions stop after one to two

days' application, and the small opening which had to be made closes.

Buried silver wire sutures that had caused suppuration in consequence of localized fascia-necrosis can usually remain, if the sinus or sinuses are regularly placed under suction-hyperemia.

A visible proof of the disinfecting power of the cupping glass is the fact that a purulent secretion from such a focus rapidly becomes serous.

Acute Infectious Inflammations within the Mouth and of the Face.

Especially to be mentioned as amenable to Bier's treatment are the acute infectious inflammations within the mouth and of the face that are brought on by the multitude of bacteria inhabiting the oral cavity: Inflammations of the gums (parulis), tooth-fistulæ, parotitis, phlegmon of the floor of the mouth, etc. All these troubles are greatly benefited by employing obstructive hyperemia in conjunction with the necessary operation.* The technique of the application of the elastic bandage around the neck has already been fully described in the general part of this book. The bandage remains in place for twenty to twenty-two hours each day, in one stretch, or twice ten to eleven hours. Here, too, abscesses require but a small incision, and the pus can in most cases be aspirated by means of suction glasses; drainage tubes and gauze tamponade are but rarely necessary. While

* It would be interesting to have dentists try to ascertain whether prolonged obstructive hyperemia, by means of the elastic neck-band, applied early, would check the progress of the thus far intractable "pyorrhea alveolaris," chronic suppurative inflammation along the alveolar processes of the jaws, which causes the teeth to become gradually loosened and ultimately lost. Of course, the hyperemic treatment could be tried in addition to the other local methods hitherto employed in these cases.

the patient may notice some tension and increase of swelling in the inflamed region, as a result of the elastic bandage, the latter must never cause sufficient discomfort to interfere with healthy sleep. If he cannot sleep well, the bandage has been put on too tight, and must be promptly removed, to be reapplied more loosely after ten minutes. Every half-way intelligent patient is able to regulate the degree of compression by his own sensations.

Parulis; Phlegmon of the Floor of the Mouth.

In cases of beginning tooth-abscess and phlegmon of the floor of the mouth, hyperemic treatment will usually promptly relieve the pain. Then, after incision of the abscess, the continued congestion produced by the treatment makes the cavity close more rapidly; it also tends to avoid bone necrosis.

Tooth-fistula.

Tooth-fistula is best treated with a suction glass. If applied at an early stage, this treatment may bring a sinus to a close without the otherwise resulting disfiguring, funnel-shaped scar formation that binds the soft tissues to the bone. Of course, the cariotic tooth or root of tooth, as also dead pieces of bone, have to be extracted, just the same as in any other treatment. But, under hyperemia, the small wound, which sometimes allows the probe to pass right out again through the alveolus into the mouth, can be brought to a permanent close with excellent cosmetic result. It is to be hoped that with the introduction of this method the always superfluous but frequently advised scraping of the bone for the cure of a tooth-fistula will at last become obsolete and pass into well deserved oblivion.

Parotitis (Mumps).

Unilateral and bilateral parotitis (mumps) can be cured by artificial hyperemia "*cito et jucunde.*" The pains promptly decrease and the entire course is a mild one.

Metastatic parotitis.

In the well-known metastatic form of parotitis, hyperemia causes the glandular tissue to break down more rapidly, and the resulting abscess shows more the characteristics of a cold abscess. This is opened by a small incision in a nonconspicuous place under the ear lobe; the wound heals without leaving any disfiguring scar.

PUERPERAL MASTITIS.

After the surgeon has grasped the indication for and technique of suction hyperemia and has gained some experience with the method in minor surgical troubles, he will want to try it in diseases of greater magnitude; such as, for instance, puerperal mastitis.

It would seem evident that if it be true that an infectious inflammation without pus formation can be successfully dealt with by artificial hyperemia, and if, further, it be a fact that by the prompt and proper application of hyperemia pus formation can be prevented, then puerperal mastitis ought to furnish splendid testing material for the truth of this teaching. And the test has been made. Numerous reports from obstetrical clinics and obstetricians generally testify to the fact that Bier's treatment does all it was expected to do in these cases.

Hyperemic treatment by suction *promptly* started and carefully carried out as soon as the first signs of a puerperal mastitis appeared, has saved a large proportion of cases from reaching the second stage of the disease; viz., that of suppuration.

It is necessary to have various sizes of glasses on hand, from which to select the exact size needed. (See Figs. 23 and 24.) After the air has been sufficiently rarefied,

the breast turns dark-red and is aspirated into the cup. The patient, after being placed comfortably (sitting on a chair or lying down), may herself hold the glass. (See Figs. 65 and 66.) A strong hyperemia will evoke a sensation of gentle tension. *Pain must never be allowed to set in.*

The suction glass remains in place for five minutes at a time, followed by two to three minutes' rest, during forty-

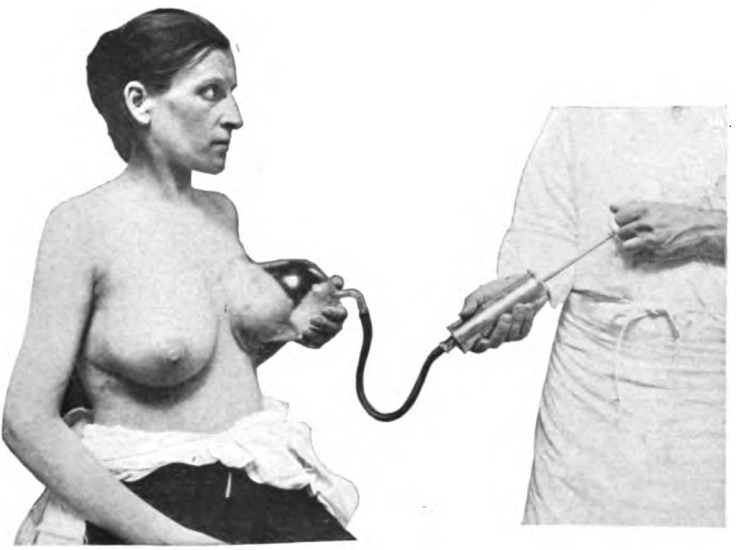

Fig. 65.—Shows the application of the large suction glass to the breast. Negative pressure is produced by the suction-pump.

five minutes each day. During the remaining twenty-three and one-quarter hours a dressing is applied which gently supports the breast. The pains usually decrease rapidly and refreshing sleep returns. The fever disappears gradually, not suddenly.

Evacuation of the Milk.

The prompt evacuation of the milk from the nursing breast is a universally accepted therapeutic principle

in cases of mastitis. The retention of milk is detrimental, as tension and pains are thereby increased and the pus is forced into the deeper strata of the gland.

If the condition of the nipple permits, it is best to allow the baby to continue to nurse, which may be done with impunity as far as the health of the baby is concerned, for we know that the seat of the inflammation is not in the acini of the glands or the milk ducts, but in the interstitial connective tissue.

Fig. 66.—A cup of smaller size with rubber tube and bulb. The patient has learned to manipulate it herself.

If the baby cannot or is not wanted to nurse, the large glass cup used for the induction of hyperemia will usually do the work of evacuating the milk. Often, however, it may be more advisable to have a special suction cup of small size placed over the nipple and areola—either before or after the hyperemic treatment—to act as a milk pump.

It is wrong, in cases of puerperal mastitis, to defer surgical intervention until distinct fluctuation becomes manifest.

Operative Treatment.

If the infiltrated area of the breast does not diminish in size under this treatment within twenty-four hours

but keeps on increasing, and if a circumscribed redness of the skin persists, the time has come for incision. But the incisions required in conjunction with hyperemic treatment differ greatly from those hitherto employed. They need not be longer than three-eighths of an inch (one cm.), but must penetrate deeply into the infiltrated area—into the abscess, if such be present—so as to obtain free exit for the pus. In case of an abscess of large size a number of such incisions should be made. Local anesthesia with the ethyl chlorid spray usually suffices to insure freedom from pain. If deemed advisable, infiltration anesthesia may be added.

The suction cup is applied right after incision, in the manner described above. The glass is cleansed of its purulent and bloody contents during the two to three minutes' intermission. Before starting the forty-five minutes' treatment-period each day, careful examination should be made to see if any new abscess or infiltration have formed. A sterile ointment dressing or a moist dressing is placed over the wound between the sittings. It prevents the formation of crusts and can be changed painlessly. If the borders of the wound show great tendency to become agglutinated, the introduction of a short drain of small caliber may prove helpful.

Any one who has once tried this treatment in mastitis must recognize its manifold advantages. It is painless, prompt in its action and leaves no ugly, disfiguring scars. The contours and function of the breast are fully preserved.

Obstetricians distinguish between mastitis due to obstruction and that caused by an infection. The former always yields nicely to hyperemic treatment. The latter,

and more frequent type, either tends to localization with abscess formation, or is of progressive character, similar to the phlegmon of the extremities.

Here the surgeon's work again lies along the borderland between conservative and radical procedure. If the patient is anxious to have the breast preserved in its shape, function and appearance, the surgeon may well continue the suction treatment, even if he has to lance as many as six to seven abscesses in the course of the treatment. The result will, in most instances, amply repay both patient and surgeon for the trouble and time bestowed upon the treatment.

If, on the other hand, the aforementioned considerations are not of importance, if the patient does not care, and the surgeon feels that he has not the time or facilities for the proper carrying-out of the treatment, it is well that he should proceed according to former methods, *i. e.*, long incisions plus drainage. He should bear in mind, however, that in severe cases of phlegmonous mastitis repeated incisions may also become necessary in the course of the after-treatment, and thus there may be no saving of time after all. Surely, we all know of cases in which it took many long and tedious weeks before ultimate cicatrization set in.

We have found two cases recorded, in which persistent adherence to the suction treatment is said to have necessitated amputation of the breast. At Bier's clinic, however, where upward of sixty cases of mastitis, including the severest types, were treated, no such experience has been had; all were cured by suction hyperemia.

Acute Infectious Inflammation of Joints (Arthritis Gonorrhoeica).

Joint Infections.

Thus far the principles of artificial hyperemic treatment have been discussed with reference to acute bacterial surgical infections, located superficially. The effect of this powerful therapeutic agent was visible; it could be easily controlled and the various phases studied.

The beginner will do well to gain his first experience with this class of cases. The treatment of articular infectious inflammations by artificial hyperemia involves far greater responsibility. Lasting stiffness of the joints (ankylosis) and general sepsis are the dreaded sequelæ to be guarded against.

A strict and refined diagnosis is the first postulate; the ability to carry out any major operation that may become necessary, the second.

In spite of the fact that hyperemic treatment of the infected joints is by no means an easy matter, it is nevertheless highly recommended, for its results with proper technique are excellent.

Indication.

To the category of acutely infected joints belong:

1. Joints in which the infection is the result of a traumatism.

2. Metastatic empyema of the joints, as observed in connection with acute osteomyelitis, etc.

3. Acute gonorrheic inflammation of serious character.

Bier teaches that such joints should be promptly subjected to obstructive hyperemia. The sooner after the onset of the articular pains the elastic bandage is applied, the better will be the result obtained. In cases in which the treatment is started within the first few hours after the pain

sets in, the improvement often is so rapid and striking that the correctness of the diagnosis may be questioned.

Technique. Time of treatment, twice ten to eleven hours per day. In the interval, elevation of the limb in order to reduce the edema. Signs indicating a favorable effect of the treatment: decrease of pain, increased mobility.

With a correct technique, the pain present in an acutely infected joint will be relieved within a few hours. This rapid abatement of the pain as the obstructive hyperemia becomes more pronounced must convince even the most skeptical of the great truth underlying Bier's teachings; namely, that by artificially increasing the symptoms of inflammation we hasten its cure.

Movements of Inflamed Joints. This release from pain—priceless boon to the patient—is doubly welcome to the attending surgeon, inasmuch as it renders possible gentle active and passive motions. For a fundamentally new factor in our therapeutics, that has followed in the trail of hyperemic treatment, is the recognition of the fallacy of the old idea of immobilizing these joints as long as possible. Such practice is productive of stiffening, the very condition which it is our aim to avoid. As soon as the pains have been sufficiently relieved to make it possible, the patient is instructed to gently move the affected joint. These passive exercises are harmless, as long as they cause no pain.

While the treatment by means of obstructive hyperemia makes greater demands upon the skill of the surgeon than the practice of incision plus drainage followed by fixation of the joints, the result amply rewards him for his pains.

Evacuation of Pus. The rule to always carefully examine into the exact condition of affairs during the interval, after the edema has

sufficiently decreased, applies also to these cases of infectious joint disease. Exploratory puncture must be extensively practised. Just as soon as pus or a sero-purulent exudate is discovered, the joint should be punctured with a large needle or trocar and then irrigated.

Irrigation of the Joints.

Saline solution is the best for this purpose, although weak antiseptic lotions may also be employed. The use of carbolic acid solution or any other strongly disinfecting chemical is advised against, as they might destroy the synovial membrane. It is not a disinfection of the synovial sac that is required, but merely a mechanical removal of the purulent fluid. This irrigation of the joint may be repeated for short periods daily, if necessary. Serous or slightly turbid fluid usually disappears under hyperemic treatment without irrigation. Bacterial examinations of the exudate will show a gradual decrease of the bacilli; the turbid evacuation becomes clear—serous.

Arthrotomy with Drainage Last Resort.

Arthrotomy with drainage is done only as a last resort; *i. e.*, if no improvement is seen under hyperemic treatment. It should be deferred as long as possible, as ankylosis usually follows.

If ever, then here experience and tact on the part of the attending surgeon are required.

The curative effect of hyperemic treatment in the case of infected joints, or other deep-seated infected foci, proves its bactericidal power.

It will be interesting, whenever it can be conveniently done, to have a bacteriologic examination made of the fluid withdrawn from the joint before and after the hyperemic treatment.

Perforative Wounds of the Joints.

Perforative wounds of the joints are covered with a loose aseptic dressing. Secretion will be much increased under artificial hyperemia.

In the event of a periarticular abscess, the same is opened by means of a small incision and aspirated with a suction glass for three-quarters of an hour each day; *i. e.* the usual six applications of five minutes each, with intermissions of two to three minutes.

Fever.

It hardly needs special mention, that the fever *gradually* disappears under this conservative régime.

Treatment.

The treatment is continued for twenty to twenty-two hours daily, until the temperature has become normal, after which it is shortened by two hours each day. After about ten days it usually can be stopped altogether. Should the fever and pains increase again during this period of gradually lessened time of application, the number of hours must be increased again.

Under such abortive treatment of an acute articular infection, pain and fever may cease within three to four days, and a complete return to normal conditions set in within ten to fourteen days. This is true principally in cases of acute gonorrhœic infection.

Felon and Phlegmon of the Tendon-Sheaths.

Felons and the phlegmon of the tendon-sheaths are pathologically closely affiliated. They will, therefore, be considered in the same chapter.

Felon (Panaritium).

Felons can be successfully treated by hyperemia by means of the elastic bandage, the latter to remain in place for twice ten to eleven hours or for twenty to twenty-two hours per day without interruption. However, the

application of the suction glass designed for the finger (Fig. 34) is preferable, and if applied early may nip the trouble in the bud.

A finger-cot is pulled over the entrance hole of the cup; then sufficient of the tip is cut off to make the inflamed finger fit in the aperture. In this way one cup will do for all sizes of fingers, and there will be no constriction at the base. A true suction hyperemia is thus produced. Rarefaction of the air within the cup is effected by a rubber bulb which the patient operates himself; or a suction pump may be employed, which requires an assistant. A red hyperemia is desired; too strong suction is apt to do harm. **Technique.**

In the ordinary case it is best to make a short incision, *even if no pus is encountered as yet*, and then immediately apply the cup. Retention of pus must never set in. **Incision.**

The wound is covered with an ointment or with a wet dressing, which prevents its borders from becoming glued together. Tampons are never used, nor are prolonged hand-baths ordered, as they macerate the skin too much. Only now and then a hand-bath is given for the sake of cleanliness. Fixation splints are superfluous. **Dressing.**

Careful observation is necessary to ascertain whether the process is a progressive one, and whether the sheaths of the tendons remain uninvolved.

Early and properly applied hyperemia may avoid necrosis of the phalanges.

In case of a subcutaneous felon in which the function of a tendon or joint are not at stake, free incision done painlessly under proper cocainization, followed by tamponade will deal more simply with the trouble and, at the same

time, constitute radical treatment. By previously moistening the tampon with peroxide the pain otherwise connected with the removal of the same may also be spared the patient.

The necrosis of the soft parts, so frequently seen in these cases, can be more speedily overcome, if not altogether avoided, by following up the above procedure by a course of obstructive hyperemia, or perhaps, better still, suction hyperemia. Then, of course, the tampon must be omitted.

For those patients who are afraid of the knife, or those for whom it is of paramount importance to preserve the normal shape of the finger-tip, *e. g.*, pianists, hyperemic treatment, employed in the beginning of the inflammation, also holds out the possibility of a cure, though with more sacrifice of time.

Phlegmon of the Tendon-sheaths.

The hyperemic treatment of phlegmon of the sheaths of the tendons is one of the most difficult and, at the same time, most important tasks of the surgeon. Here the new teaching of Bier is put to the test as to its ability to master serious infections.

So far, the principle of modern surgery in treating this kind of cases has been:

1. Elevation—to oppose venous stasis—with its subsequent interference with proper nutrition (necrosis). 2. Free incision, so as to give unobstructed exit to the bacteria and their toxins, in conjunction with proper drainage. 3. Rest of the affected part, in order to prevent involvement of the adjacent tissues. 4. No mechanical insult to the protective wall, furnished by the granulating wound.

This treatment often ended with necrosis of the tendon or tendons, with impeded motion, or entire loss of function

of fingers or hand, in spite of most careful surgical supervision. The results of Bier's hyperemic method are more satisfactory. The tendon and its function are usually preserved.

The rules for the accomplishment of this purpose are:

1. Obstructive hyperemia, bringing more blood to the spot where the fight goes on, in order to aid the system in its endeavor to overcome the invading foe.

2. Small multiple incisions, without drainage.

3. Gentle pressing of the parts toward the incision, to facilitate the evacuation of the pus.

4. Early active and passive motions, to guard against the threatening stiffening.

In other words, the formerly generally accepted and practised radical procedure is transformed into a conservative one.

This does not mean, however, that now the general practitioner is expected to take care of these patients, in whom the question of the proper functioning of a most important part of the human body—at least as far as the working-classes are concerned—often even their very life, is at stake. No; now, as before, these patients belong to the hospital. They should be placed under the most rigid permanent observation, and in a place where, if occasion arises, the necessary operation can be promptly performed. This point cannot be too strongly emphasized.

Technique.

The physician who sees a case of this kind in the beginning of the infection, shortly after the injury was sustained, can prevent the development of an infectious inflammation by promptly arranging for obstructive hyperemia, for twenty to twenty-two hours per day.

The anatomic changes at this stage of the disease are

hyperemia of the sheaths of the tendons and exudation of turbid serum.

Of course, most careful examination of such recent cases is imperative. If tenderness along the course of the respective tendon, impeded function, fever and general malaise are present, it must be assumed that pus has already formed, and such pus must have a prompt exit.

It is generally recognized that this disease is of graver consequences at the hand than at the foot, and more serious at the volar, than at the dorsal, aspect of the hand.

Anatomic Description.

Anatomy teaches that the second, third and fourth fingers have double sheaths for their flexor tendons. The distal one extends from the tip of the finger to about its base. (Fig. 67, *a*, *a*, *a*.) They have no intercommunication with one another, nor with the large synovial sac in the palm of the hand. The fifth (small) finger makes an exception. The continuation of its synovial membrane is the large hour-glass-shaped sac (Fig. 67, *b*) crossed by the transverse ligament at the wrist. (Fig. 67, *f*.) The thumb has a long sheath of its own for its flexor tendons. It passes underneath the transverse ligament, and usually does not connect with the large synovial palmar sac, but is immediately adjacent to it. (Fig. 67, *c*.) The tendon of the flexor carpi radialis muscle has a special, short sheath, right in front of its insertion at the base of the second metacarpal bone. (Fig. 67, *d*.)

Advance of the Infectious Process.

For a short time an acute infectious inflammation respects the anatomic border line. Then, however, it breaks through the same and inundates the surrounding connective tissue, at times also extending to the neighboring tendon-sheaths.

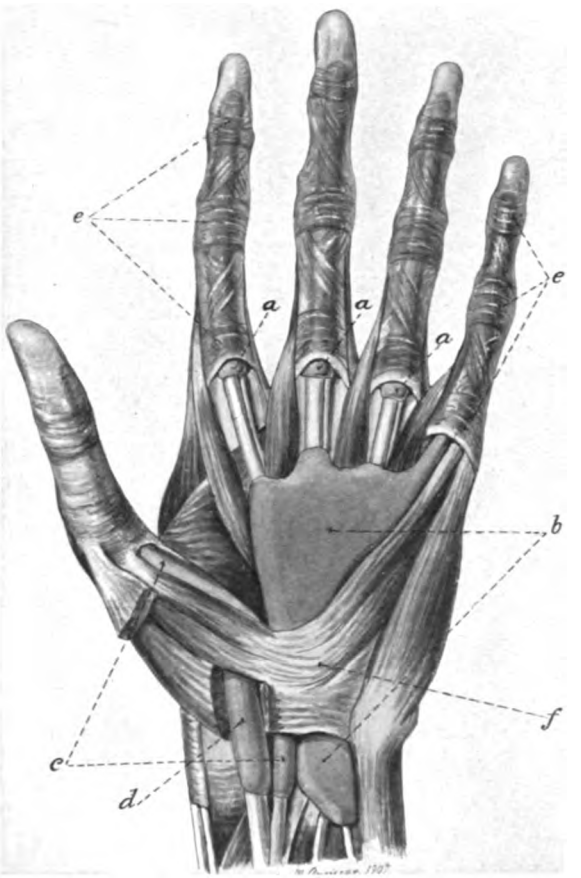

Fig. 67.—Illustrates the anatomy of the palm of the hand with especial reference to the synovial sacs of the tendon-sheaths. *a*, *a*, *a*, Show the lower end of the peripheric sheath for the second, third, and fourth finger. *b*, The large palmar sac, through which run the flexor tendons of the second, third, fourth, and fifth finger. It is crossed by the broad transverse ligament, *f*, the latter rendering it hour-glass shaped. The flexor sheath of the small finger communicates with this directly; therefore, injuries to the same are most dangerous. *c*, Shows the flexor sheath of the thumb, the lower horizontal line leading to the close proximity of the same to the large palmar bursa itself. *d*, Points to the sheath of the flexor carpi radialis which not infrequently becomes infected in connection with inflammation of the other flexor sheaths. *e*, *e*, Indicate the transverse volar ligaments of the fingers, which should be most carefully avoided when operating. A long incision, from the tip of the finger toward the palm, as practised by many, naturally divides the same, thereby permitting the tendon to leave its normal place, which usually means death to the tendon.

The rapid progress of a virulent infection of the fifth finger to the large palmar sac, thence to the flexor sheath of the thumb, and finally to the wrist-joint and the interstices of the muscles of the forearm, is a well-known clinical picture.

The inflammatory exudate within the extremely tense connective tissue of the palm of the hand soon becomes subjected to a high degree of pressure, which, in turn, pushes on the infectious process and produces the concomitant edema of the dorsal aspect of hands and fingers, which so often is mistaken for a phlegmon of the dorsum.

Incision. Any accumulation of pus needs prompt evacuation. Short incisions are to be made wherever the presence of pus is suspected, also outside of the sheaths; *i. e.*, into the surrounding connective tissue. Care must be taken not to injure the transverse ligaments at the fingers (Fig. 67, *e*), since the division of these, as is well known, usually means loss of the tendon. They must, therefore, be preserved at all hazards, a rule which has always been observed by careful surgeons. (Fig. 68.)

Regarding the size of the incisions, they have learned at Bier's clinic to get along with comparatively small cuts. However, the surgeon who has not yet had very much experience with the method, may prefer a wider exit for the infected exudate and wound secretions, to which there is no objection other than that the resulting scars will be longer.

The infected sheath is best opened over the volar aspect of the metacarpo-phalangeal joint and that of the first and second phalanx (Fig. 68), corresponding to the line of the skin incision, or somewhat laterally to the same.

It is thoroughly relieved of its contents by gentle pressure of the soft parts. Gauze tamponade or drainage with tubes is not employed. For a few hours (two to three) a gently and lightly compressing dressing is applied. When the danger of hemorrhage has passed, this dressing is changed for an aseptic towel, folded loosely around the

Fig. 68.—Shows where the multiple incisions should best be made in case of suppuration within the tendon-sheaths of the volar flexors.

dressings covering the hand (see Fig. 4), and obstructive hyperemia is started with the elastic bandage around the arm for twenty to twenty-two out of the twenty-four hours. Before reapplying the bandage, the parts must be carefully examined to see if the infection has spread further, in which event additional incisions should be immediately made.

During the intervals, the arm is elevated, in order to reduce the edema.

The tendons are not exposed during the treatment; they remain covered by the soft parts and are bathed by the continuous current of serum that finds its exit through the incisions. All this tends to save the tendon from necrosis. The incisions do not usually heal before the virulent stage of the infection has passed. Should scabs form nevertheless, they have to be removed either with dressing forceps or by means of a warm hand-bath.

The time of application of the band is reduced by two hours each day, as soon as the temperature has subsided and the more serious symptoms have disappeared.

During the entire course of the treatment, gentle active exercises with the fingers are insisted upon; passive motions are carefully made by the surgeon whenever the dressing is changed. This will prevent the formation of adhesions between the tendons and their sheaths.

These cases, if treated early in accordance with the principles laid down by Bier, will usually come out with the tendons preserved.

More advanced cases, with suppuration of several days' standing, inside and outside of the tendon-sheaths, often showing the tendons in beginning necrosis, cannot, of course, be fully restored, even by the most carefully conducted hyperemic treatment. Yet, if promptly started, if may often still succeed in maintaining the function of the finger to some extent at least. In these advanced cases it is wise to make the incisions somewhat longer. (Fig. 69.)

In the cases seen early the first few days of treatment

will determine the life or death of the tendon. Most careful observation, strict diagnosis regarding the possible further accumulation of pus, which then requires prompt

Fig. 69.—Shows a severe phlegmon of the hand and forearm. The second phalanx of the thumb was lost in consequence of a subperiosteal felon with subsequent necrosis. With the help of incisions in the palm of the hand and volar aspect of the forearm, the patient was cured with good function.

additional incisions, and intelligent criticism are essential to good work. We know how often a virulent progressive infection of the sheaths invades first the joints of the

fingers, then of the carpus and finally extends to the wrist. These complications must be recognized in time, and the inflamed joints incised and then promptly treated.

The usually resulting stiffness may be mobilized by hot-air treatment and expert massage.

In few surgical diseases is an early and correct diagnosis of more importance than in acute inflammation of the flexor tendon-sheaths. In few will the *early careful application of hyperemia* do more good in a preventive way. Months of suffering can thereby be spared the patient, and endless worry and deprivation to a workman's family. It is a triumph to have such a patient come out with movable fingers and a useful hand.

It is true, a certain percentage will have perfect function also when treated after the manner so far in vogue, but after how many weeks of painful operative work and after-treatment, surgical and mechanical!

Bier's hyperemia if started early, can accomplish this with little pain and discomfort to the patient and in considerably less time. Of course, in cases in which the disease has made much headway, in which venous stasis with thrombosis of the veins and beginning necrosis have set in, artificial hyperemia is also helpless. It may hasten the process by a more rapid pus formation; it may facilitate the secretion; it may at best save a part of the tendon if the whole was not doomed from the start; but it cannot restore life to dead parts.

Therefore, let the general practitioner, who usually sees these cases first, remember that *here hours count;* let him make it his business to study and master the essentials of the method; let him act promptly and send the

patient, with the elastic bandage properly around the arm, to a hospital. For these cases are hospital cases and need careful attention by expert surgeons, until the infection has been brought under control.

Exceptionally, a few short incisions into an infected tendon-sheath prior to starting the hyperemic treatment *prophylactically*, may become advisable, especially in cases of streptococcus infection. For it seems necessary, in the very virulent cases at least, that the serous exudation promptly produced by the infectious process plus the serum engendered as a result of the prolonged application of the elastic bandage, have an outlet from the closed sac that we call the tendon-sheath.

It certainly is possible that infectious inflammations exist in which primary obstructive hyperemia, viz., increased inflammation, without providing for an outlet of the inflammatory exudate, can do harm.

In view of our inability to determine the species of cocci which is responsible for the acute tenosynovitis without having opened the sheath of tendon, further experience may show it to be advisable to make primary incisions into the sheath in every instance.

In order to establish more exact lines as to which of the great variety of this class of cases can be principally benefited by artificial hyperemia, it has been recommended to have a primary bacteriologic examination made, especially in cases in which there is no open wound, or those that have not received surgical treatment elsewhere.

In cases in which the preservation of a tendon or joint is not at stake—*e. g.*, in a case of *subcutaneous* phlegmon of the arm, with or without fascia-necrosis—it may not be

worth the trouble and worry to try artificial hyperemia. A number of good-sized incisions, and drainage with tubes for a few days—in other words, the old method of treatment—will usually effect a cure. Those who have acquired sufficient experience with Bier's treatment may add obstructive hyperemia. However, just in these cases there seems to be great tendency to skin-necrosis. Hence the advisability of here applying hyperemia still remains a mooted question.

On the other hand, lymphangitis and erysipelas, which may follow our surgical work in streptococcous infection, are often successfully dealt with by the obstructing elastic band. Nevertheless an erysipelatous reddening has often been seen to advance up to the elastic bandage, but it was usually much less virulent than the ordinary erysipelas.

In view of the facts stated, it will simplify the work in our hospitals if cases of *subcutaneous phlegmon* are treated as before. A laborer does not care whether his incisions are three to four or one inch long. However, when it comes to a young woman of society, conditions are different. Here the cosmetic result may be of great importance, and it is comforting in such a case to know a method of treatment which, although requiring continuous great care and attention, may accomplish a cure with very little disfigurement.

Acute Osteomyelitis.

Acute Osteomyelitis

The experience gathered with obstructive hyperemia in acute surgical infections of the soft tissues invited a test of its bactericidal effect also in the acute suppurative inflammation of the bone-marrow—in acute osteomyelitis.

There can be no doubt that in cases in which obstructive hyperemia is applied early and faithfully for twenty to twenty-two hours per day, a beginning conflagration can be extinguished, although it is well-nigh impossible in these cases to prove that the diagnosis was correct after the symptoms have subsided. It is, however, but logical to assume that in this affection, same as in all other types of infectious disease mentioned, an *early* diagnosis and *prompt* application of hyperemia, based on such timely, correct interpretation of the existing symptoms, can prevent months of serious illness as well as serious surgical intervention.

In severe cases primary opening of the bone cavity, followed by strict hyperemic treatment, is undoubtedly the surest road to recovery. Nevertheless, it should be mentioned that a number of authors have accomplished the same result, *without* primary opening of the bone cavity, by means of hyperemia alone.

Advanced cases would better be subjected to operation in accordance with accepted principles, plus artificial hyperemia.

In young children, thorough incision of the abscess often suffices. Drainage of the central cavity and chiseling away of the covering part of the bone are not imperative.

Hyperemia at first causes voluminous secretion, after the cessation of which, in the absence of bone necrosis, the wound may close without the formation of a sequestrum.

In the chapter on phlegmons of the hand it was emphasized that the main object of the hyperemic treatment is the preservation of the endangered tendon. The same preservation of tissues is attempted in acute osteomyelitis.

Tamponade is abolished in order to avoid, if possible, the formation of large sequestra; for the piece of gauze or drainage tube that, according to former practice, was used to cover the tendon in the case of a phlegmon really favors its necrosis, as Bier has shown. In view of this his finding, drainage is abolished also in these acute inflammations, in order to prevent the drying out of the bone. The latter is to remain covered with soft parts as far as this can be done in a given case.

With this end in view, the operation in a case of acute osteomyelitis is carried out as follows: The abscess is incised and irrigated or the bone opened. Then the skin edges are brought together again by means of retention sutures, 1½ to 2 inches (4 to 5 cm.) apart, which are but loosely tied. Sufficient space must remain between the sutures to permit of free exit of the secretion.

This treatment tends to retard the spread of the necrosis of the bone, as has been proven by subsequent sequestrotomy.

In cases in which necrosis of the bone could not be avoided, it will be seen that hyperemic treatment favors the rapid formation of the bone cavity encasing the sequestrum, and also facilitates the loosening of the latter.

It should be borne in mind that hyperemic treatment of acute osteomyelitis is still in its infancy. Further experience is sorely needed. So far, its results have been but moderately satisfactory.

No surgeon who does not thoroughly master the technique of hyperemic treatment should venture to try it in these usually grave infections.

The possible advent of metastatic abscesses, especially

in joints, must be borne in mind and careful examination made accordingly.

That patients stricken with acute osteomyelitis are hospital cases need hardly be stated.

Recurrent Osteomyelitis.

Recurrent Osteomyelitis.

In cases of recurrent osteomyelitis, viz., sinus formation along the line of the scar after operations for acute osteomyelitis or its sequela (sequestrotomy), hyperemic treatment by means of the elastic bandage plus the suction cups, will often be found extremely useful.

Erysipelas.

Erysipelas.

A few words must be devoted to the effect of artificial hyperemia in erysipelas.

Although further observations are needed, to fully estimate its true value, this much can be definitely stated even now, that in erysipelas of the head and face the application of obstructive hyperemia by means of the elastic neck-band shortens the duration of the disease, and improves the patient's general condition, not only in the way of a prompt reduction of the temperature, but also in producing early and pronounced desquamation.

Hyperemia should be continued for a few days even after the temperature has returned to normal.

It seems justifiable to assume that the good results that have been obtained with the well-known method of applying rather tightly circular strips of adhesive plaster near the border-line of the erysipelas within healthy skin, have been due to the hyperemia thus induced.

The erratic course of so many cases of erysipelas, of course, renders attempts at fighting its progress often illusory, no matter what method of treatment be employed.

OBSTRUCTIVE HYPEREMIA AS A PROPHYLACTIC.

Obstructive Hyperemia as a Prophylactic.

The recognition that Bier's hyperemic treatment can successfully overcome an acute infection, and that the earlier it is applied, the more striking is its effect, evolved the idea of the possible prophylactic value of this powerful agent in preventing inflammation and suppuration in cases of soiled wounds, or at least having the inflammation take as mild a course as possible.

Soiled Wounds.

Under the old régime, if a patient came under our care who had just sustained a division of tendons and muscles with visible soiling of the wound, we would abstain from performing immediate tenorrhaphy. We would clean and dress the wound and suture the tendons when the danger of inflammation had subsided. The increased difficulty and doubtful result of such secondary suturing are sufficiently known.

According to Bier, if the contamination of the wound is not too severe and the tissues are not too seriously mangled and torn, such wounds are gently irrigated with physiologic salt solution, avoiding rough handling and all scrubbing, and tendons and muscles are united with chromicized gut; the skin is closed with sutures of silk or fine silver wire, placed sufficiently far apart to insure free exit of the wound secretion. No drainage of any kind is employed. First, a slightly compressing dressing is applied, to guard against hemorrhage. About three hours later this is replaced by a loose one and prophylactic hyperemic treatment is started, just as if we had to deal with a true infection.

As has been often said before, the elastic bandage remains in place for twenty to twenty-two hours each day.

The secretion, which is usually abundant, is at first sero-sanguinolent in character and may later become purulent. So long as suppuration, redness, fever, and pains continue and the edema is marked, the bandage must be strictly applied for the full length of time. After the symptoms subside the time is *gradually* reduced. The treatment must never be abruptly interrupted.

Fig. 70.—This illustration shows a man who sustained a deep and large soiled wound of the volar aspect of the forearm. After careful cleansing, the tendons and muscles were sutured and the skin closed. Rise of temperature soon set in. Under the immediate application of the elastic bandage for twenty hours per day, the fever dropped and the wound healed throughout in spite of sero-purulent secretion.

Under this régime one often sees divided tissues unite without complications. Of course, the resulting scar does not correspond in appearance to that following aseptic healing of a wound. Still, it is linear. Fig. 70 illustrates the result obtained in a case of this kind.

The advantages of this procedure are evident. It is necessary, however, to again call attention to the necessity of individualizing in these cases. It is not to be expected that hyperemic treatment will furnish a good result in *every* case, no matter how badly soiled. It cannot do this. It is not a panacea.

If the wound is not too extensively soiled, this prophylactic treatment may well be tried. But the surgeon has to be on his guard, and promptly open the wound should progressive suppuration set in. *The pus must have an exit; retention cannot be tolerated*, possible hidden abscesses have to be searched for.

This prophylactic hyperemic treatment seems destined to restrict somewhat the free incisions and operative after-treatment of infected foci. No doubt good results were obtained with the latter method, as far as healing was concerned, but the preservation of function was often somewhat neglected.

The most striking results of Bier's treatment have been obtained in this class of cases. Such patients are, therefore, suitable material for the beginner. Later he may undertake the treatment of the more serious affections, always exercising the utmost care and watchfulness lest he miss the proper moment for the various steps that may become necessary in the course of the treatment.

Compound Injuries of Fingers and Hands.

The compound injuries to the fingers and the severe crushings of the hand so frequently observed in industrial towns are greatly benefited by prophylactic obstructive hyperemia.

Under our former mode of treatment the necessary examination as to the extent of the injury was very pain-

ful, often harmful; the serious swelling of the parts made a strict diagnosis as to division of tendons and opening of joints rather difficult; it was impossible to determine whether or not the irregular shreds of the lacerated skin and how much of the crushed and broken bones would live. The *x*-ray alone could show the extent of bone destruction. Hence conservative treatment could only rarely be carried out.

With the prompt application of Bier's treatment, on the other hand, copious secretion from the wound is promptly started, the contaminating particles are thereby washed away, and, usually sooner than expected, healing takes place. The reduced sensitiveness permits of early motions which prevent stiffening.

The possibility of thus saving, for instance, a hand or even part of a hand to a man who lives by manual labor certainly ought to be sufficient incentive to the surgeon to most carefully study a method that holds out such promise.

Under Bier's treatment operations on these mangled limbs rarely become necessary; they are resorted to only in cases of exceptionally severe crushing. Secondary operations for the correction of the stump can be reduced to a minimum.

If articulations of fingers, etc., must nevertheless be done, the hyperemic treatment following the operation promptly, will overcome the necessity of drainage.

Injuries Sustained by Physicians in the Course of Operations or Autopsies.

In this connection it may be well to call attention to the value of the treatment in the finger injuries sometimes received by physicians during septic operations or post-mortem examinations. Prompt prophylactic hyperemic

treatment will prevent many a serious lymphangitis or lymphadenitis. It is best, immediately after the wound has been inflicted, no matter how small it may be, to stop in the operation, if at all possible, long enough to squeeze the finger until blood appears, cover it with a small piece of wet sterile gauze, draw a finger-cot over the same and slip a small rubber band over the base of the finger, as shown in Fig. 63. Then, after putting on the glove again, the operation can be proceeded with.* Later a second rubber band may be applied in order to increase the passive hyperemia. Of course, the constriction must not be painful. It will be advisable for the physician to always carry in his pocket a small box containing rubber cots and bands. They should also be kept ready (sterilized) for emergencies at our hospitals.

In case of the infliction of a deeper wound on the fingers, as also in the event of injury to the first phalanx, metacarpal or carpal region, obstructive hyperemia with the bandage around the arm should be employed, as soon as the operation or dissection has been finished.

APPENDIX.

COMPOUND FRACTURES.

Compound Fractures.

The expert may use Bier's hyperemia to advantage also in cases of compound fracture.

The question that usually arises in these cases is: Shall we temporize, or shall we at once proceed to revise the fracture; that is to say, lay open the fragments, clean, shape, unite, etc., and then treat the wound according to indications? As a rule, the former course is decided upon

* If gloves and finger-cots are not or can not be worn, the rubber band should at least be slipped over.

for the less severe cases, the latter for the more serious cases.

Obstructive hyperemia, begun as soon as the wounds have been properly attended to and protected by a loosely applied aseptic dressing, with the limb placed on splints, seems destined to shift the borderline between these two modes of treatment in favor of the conservative plan.

To be successful, the treatment has to be applied faithfully for twenty hours each day; regular and careful examination has to be made in order to detect any possible retention of serum, or pus formation. As the pain decreases, the position of the fragments is gradually corrected, always under continuance of the loose aseptic dressing. As soon as the time for a threatening infection has passed, a plaster-of-Paris splint with one or more cut-outs is applied and the hyperemic treatment discontinued.

One of the most dreaded of compound fractures is that of the base of the skull. Intracranial hemorrhage and meningitis here endanger the patient's life.

Of all the methods of treatment known and used nowadays, prophylactic hyperemia of the head with the elastic band around the neck, started immediately after the injury, seems to promise the best results in these cases, as it is most apt to prevent meningitis. Nor is it to be feared, in view of the absorbing qualities of hyperemia, that it will produce or increase intracranial bleeding.

Comparative statistics of cases, treated by this and the other methods, would be best adapted to definitely establish the merits or demerits of this proposed prophylactic treatment.

It need hardly be added that compound fractures are hospital cases, and physicians will do well to urge their

patients to enter a hospital or clinic, where they have the advantages of strict asepsis and continuous observation by competent physicians and nurses.

CHRONIC INFECTIONS.

Tuberculosis.

1. **Tuberculosis of Joints.**—This section is of especial interest, inasmuch as it was the treatment of this trouble that gave birth to the use of hyperemic treatment. The principal studies in regard to the peculiarities and effect of this therapeutic agent have been made on patients afflicted with tuberculous joint-disease.

After a most interesting development, the treatment of tuberculosis of the joints by means of artificial hyperemia has been brought to such a stage of perfection that it may now be looked upon as one of our most important aids in the conquest of this class of diseases.

It is to be emphasized right here that artificial hyperemia requires longer to effect a cure than operative treatment, a drawback which it has in common with all other conservative methods. He who desires to be cured quickly would probably better submit to resection or amputation.

The laborer dependent upon his wages for a living for himself and family will probably be earlier able after an operation to resume his work than if treated by hyperemia. And it must be admitted that our present refined methods of resection, particularly if Mosetig's iodoform fillings be employed for the resulting cavity, insure a quick and usually good functional result, at least in the wrist-, elbow-, and ankle-joint. Yet this mutilating treatment could not be the final aim of scientific surgery; and

we now have something better in Bier's hyperemic treatment, which aims to restore *perfect* function without sacrificing any part of the limb or joint itself.

It is true a great deal of patience and perseverance are required to attain this end, as it takes many months (about twelve to fifteen) of treatment and careful medical supervision; but the final result in most cases amply repays both patient and surgeon.

It is difficult to give a correct explanation for the curative effect of artificial hyperemia in tuberculous cases. The best seems to be, that *gradually* connective (scar-) tissue takes the place of the tuberculous, and that connective tissue does not represent a soil in which the tubercle bacillus can flourish. It dies, and therewith its pathologic sequelæ come to an end.

Form of Hyperemia.

In the treatment of surgical tuberculosis obstructive hyperemia only, by elastic bandage or suction glasses, is used; never hot air.

The elastic bandage is used far more extensively than suction glasses. It can be nicely applied in tuberculous inflammations in the greater number of joints of the extremities, including the shoulder.

It is to be regretted that, so far, the hip-joint cannot be subjected to this treatment, the impossibility being given by the necessity of employing venous hyperemia only.*

Duration of Obstructive Hyperemia.

As a rule, a tuberculous joint is treated with obstructive hyperemia twice a day for one hour, although this rule may have to be modified in some instances. If observation shows that a somewhat longer duration of treatment gives a better result, also as regards relieving the pain, the time may be extended to twice two hours per day.

* See page 36, foot-note.

In severe and rapidly progressive cases a still longer duration of obstructive hyperemia, twice per day, may become necessary.

In cases of hot abscess-formation with fever, due to mixed infection of the sinuses present, the treatment will have to be extended to twice eleven hours per day. After the acute stage has passed, the shorter periods of treatment, with nine to eleven hours intermission, are resumed.*

This shows that here, as elsewhere, we have to individualize. At times a period of continuous improvement is followed by one of comparatively little improvement in spite of most painstaking application. In such an event it may be advisable to discontinue the treatment for a while, say from six to eight days, after which the resumed treatment will often yield more satisfactory results.

To understand this, it must be borne in mind that obstructive hyperemia acts like a powerful drug, the dosage of which must be adapted to the individual case.

But, as has been stated above, the general rule in uncomplicated cases of tuberculous joint disease is, to apply the elastic bandage twice, one hour per day. During this time the induction of a "strong hyperemia" should be the aim, that is to say, that part of the extremity

* Originally Bier advised obstructive hyperemia for eleven hours of each twelve for tuberculous cases. It was seen, however, in course of time, that a persistent chronic edema appeared, which often gave rise to the development of erysipelas in fistulous (open) cases. The cause for the setting in of such unwelcome complication evidently is the edema-fluid, the bactericidal power of which had been used up.

Since employing the obstructive hyperemia twice per day for one to two hours only, a complicating erysipelas has not been observed by Bier again.

which is distal to the bandage should turn a bluish-red, without, however, becoming painful.

The possibility of a good result from such brief applications of the elastic bandage twice per day, is certainly a great boon to patients belonging to the working classes.

They can apply the treatment in the morning before going to work and again after their return at night, meanwhile carrying the arm in a sling, making themselves useful with one arm, or performing some light work with both, as soon as some improvement has set in. If the lower extremity be involved, they can apply for work that can be done mostly in a sitting posture. In this way they can at least earn some money and will not be an absolute burden to the community or their families during the long course of the treatment. Of course, it would be far better if such patients did not have to work, but could enjoy outdoor life.

Technique.

The bandage must always cover a perfectly healthy part of the extremity, not too close to the diseased joint. In tuberculous affections of the elbow and joints below the same the bandage is best applied around the arm. (Fig. 71.)

For the treatment of the shoulder-joint an elastic tube is employed instead of a bandage; this is kept in place by means of strips of muslin or gauze, fastened in a simple way. (See Fig. 5.) Special care must be exercised in the treatment of these cases, as the elastic tube necessarily always encircles the same spot, and, hence, may give rise to pressure necrosis of the skin.

In cases of tuberculosis of the knee, tibiotarsal articulation, and the small joints of the foot the bandage is worn around the thigh.

In stout patients the elastic bandage has to be wider—3 to 3½ inches (8 to 9 cm.)—and is best made to cover a thin gauze compress or a layer of cotton, as otherwise, owing to the tapering form of the thigh, it would be likely to be pulled into a narrow band and cause pain.

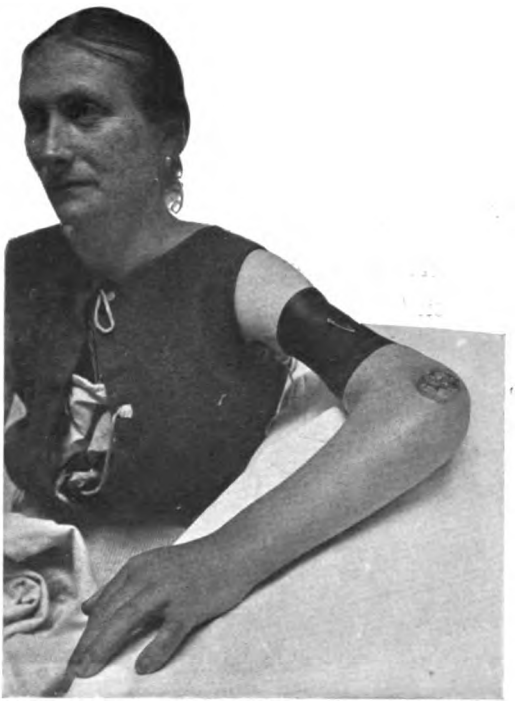

Fig. 71.—This illustration shows the manner of application of the elastic bandage in a case of fistulous tuberculosis of the elbow-joint.

In order to increase the effect of the bandage, a hot bath of the parts of, say, ten minutes' duration may be helpful.

After the removal of the bandage the portion of the extremity that was subjected to the elastic compression is thoroughly massaged in order to guard against pressure

atrophy of the muscles. For the same reason the bandage is never reapplied in exactly the same spot, but 1 to 1½ inches (3 to 4 cm.) further up or down, thus wandering between the joint above and a place of safe distance from the focus of the disease.

As a rule, all dressings (in the case of open tuberculosis)

Fig. 72.—Shows the patient with tuberculosis of the elbow represented by Fig. 71 with the suction glass in operation.

are removed while the bandage is in place. The sinuses are loosely covered with aseptic gauze, and the limb is wrapped in a towel so as to retain its warmth.

In addition to the elastic bandage, suction glasses are applied in these cases of open bone tuberculosis for forty-

five minutes per day, with the usual interruptions; that is six to five minutes on and two to three minutes off, but best while the bandage is *not* in place. (Fig. 72.) Care must be taken to select the proper size of glass.

By means of this local suction-hyperemia whatever purulent secretions and necrotic shreds may be present are aspirated.

The joints are *not* put in fixation splints during treatment. If but a minimum degree of mobility is left, the patient is urged to gently but frequently exercise the joint, in order to preserve and increase such mobility.

Only extremely painful joints are immobilized, but the splint is left off just as soon as the sensitiveness subsides.

Permissibility of Using the Diseased Joints.

If no pain be experienced, the patient may use the affected limb to some extent. He may dress himself in the presence of a diseased joint of the upper extremity. He may be out of bed part of the time each day, with a tuberculous knee- or foot-joint. But in the latter case the joint must be carefully protected against overweight. Pressure of the two diseased articulating surfaces is strictly to be avoided. So long as these joints are in an inflammatory stage, the patient has to wear a support of some kind and use crutches or a cane. The best and safest way to guard against unduly burdening the joints with the weight of the body, is to apply a movable splint while the patient is out of bed (Figs. 73 and 74); the active exercises to be undertaken while he is in bed.

In order to avoid misunderstanding it should be stated right here, that neither a systematic movement-therapy nor brisement forcé is ever indicated. Such procedure would surely make things worse. The patient must

know that traumatism of any kind is apt to again light up the receding trouble.

In the cases in which the local trouble has reached an advanced stage, or contracture of the joint has set in, **Contractures.**

Fig. 73.

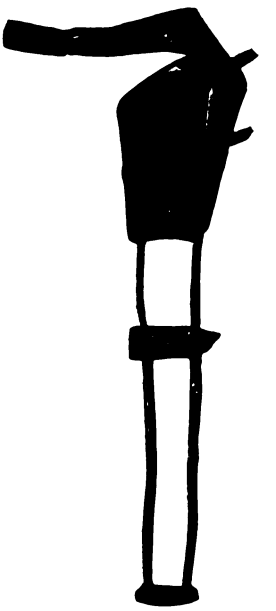

Fig. 74.

Fig. 73.—Shows a plaster-of-paris support, easily improvised by the surgeon. A snugly fitting splint reaches from the ankles to the tuber ischii. It carries at its lower end a stirrup, lifting the foot above ground. By splitting this splint open in front and behind, it is made movable. It is lined with felt and applied to the extremity by means of a few straps fastened by buckles. By taking its support on the pelvis, the knee will not bear any weight. It is not fixated. A cork sole under or in the shoe of the healthy side corrects the difference in length. The apparatus is applied as soon as the knee has become straightened and painless under the hyperemic treatment.

Fig. 74.—Illustrates the same idea as carried out by the instrument-maker. The machine is worked from a plaster cast.

gradual reposition is to be combined with hyperemic treatment. This has reference especially to the knee, where the pathologic posture is usually obstinate and easily leads to subluxation. An adhesive-plaster extension splint is promptly applied in these cases and obstructive hyperemia begun at the same time. The splint leaves the knee fully exposed and remains in place until the

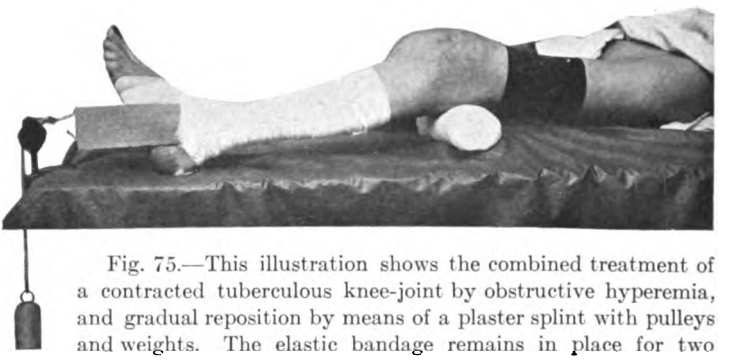

Fig. 75.—This illustration shows the combined treatment of a contracted tuberculous knee-joint by obstructive hyperemia, and gradual reposition by means of a plaster splint with pulleys and weights. The elastic bandage remains in place for two hours, twice a day, the splint continuously. Atrophy of the extremity and fungous swelling of the knee are evident. There is no tuberculous hydrops. Only light weights are used, 5 to 8 pounds in adults, 2 to 3 pounds in children. To avoid any sudden stretching, a safety roll is placed in the popliteal space, which is gradually reduced in circumference. The patient shown in the illustration entered the hospital ten days previously with a very painful limb, contracted at right angles. Now it is much less sensitive and quite movable; the swelling is reduced. The knee is daily examined to make sure that no cold abscess be forming.

extremity is straightened. Then it is dispensed with and brought into use again only in case of a return of the contracture. (Fig. 75.)

The Course of the Disease under Hyperemic Treatment.

Improvement in such joints usually sets in in the course of a number of weeks. Nights disturbed by pain give way to restful sleep. Swelling and pain recede. The contours of the joint become more defined and mobility increases.

The latter constitutes one of the principal advantages of Bier's treatment. Whereas we have been accustomed to looking upon joint stiffness as a characteristic result of joint tuberculosis, we have learned through Bier's treatment that this phenomenon has often been due to our therapeutic measures rather than to the disease itself.

In a number of cases a cold abscess forms, which, of course, must be evacuated.

While an open tuberculous process represents a graver form of the trouble, it has often been noted that a turn for the better sets in as soon as this breaking down occurs. The system seems to rid itself of the necrotic tissue by way of suppurative softening, resulting in a cold abscess. This then is opened by means of a small incision, the pus is allowed to escape, and the sinus is placed under artificial suction hyperemia. (Fig. 76.) In favorable cases the secretions soon become serous under this régime, gradually cease, and the sinus closes.

Here, again, the same important rule for the successful carrying out of obstructive hyperemia applies: opening of the abscess in order to evacuate the pus.

Yet, aspiration plus injection of sterilized iodoform-glycerin-emulsion (five to ten per cent.) also remains a recommendable procedure, in conjunction with Bier's hyperemic treatment, when dealing with the ordinary cold abscess, principally in private practice. Such combined treatment is advisable in cases in which the surgeon has not the time to personally attend to the patient for about one hour daily and a nurse is not available, or if lack of intelligence on the part of the patient or his relatives makes the surgeon fear that his instructions will not be properly carried out.

It is recommended that the physician who employs Bier's hyperemic treatment follow it up in a scientific manner; namely, that he carefully note, at the time of starting, the degree of mobility, the circumference, sensitive spots, the beginning of softening, etc. In fact, it would be very interesting and instructive to take an

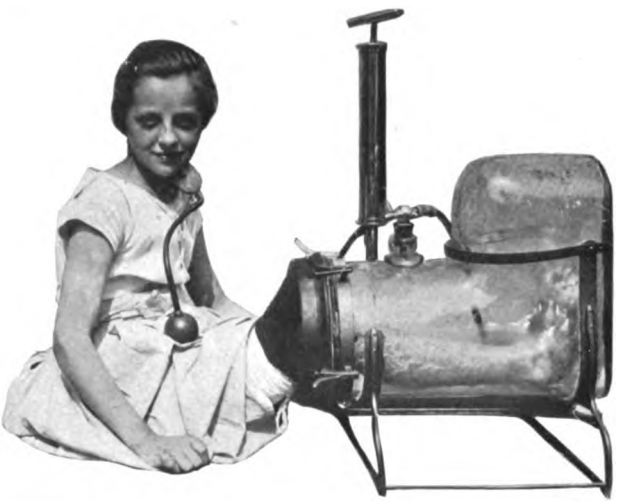

Fig. 76.—This illustration represents a little girl with a serious tuberculous affection of the metatarsus. Hyperemia is produced by a suction glass of large size. A smaller glass covers a sinus at the neck, being the result of a tuberculous glandular trouble.

x-ray picture at that time. This would often clearly show tuberculous foci in the bones which, by the way, would not mean a contraindication to the use of obstructive hyperemia. Well-defined tuberculous sequestra should, of course, be removed by operation.

Tuberculosis of the Spinal Column (Pott's Disease of the Spine).

Tuberculosis of the Spine, Ilio-sacral Joint and Os Sacrum.—Tuberculosis of the spine can also be treated by artificial hyperemia. The earlier it is applied, the more promising the result. Of course, only suction glasses can

be made use of. Experiments and experience have shown that the hyperemic depth-effect of these glasses amounts to several inches. We can thus understand how the diseased body of the vertebræ may be placed under artificial hyperemia in this manner.

The selection of the proper size of glass is of greatest importance. The glass should be large and cover a number of vertebræ above and below the affected region. According to location, the brim of the glass must be straight or U-shaped. In cases in which it does not readily adhere one may facilitate air-tight suction by pushing the neighboring skin and muscles toward the apparatus, the rim of which should always be anointed with a mixture of lanolin and vaselin, equal parts, or by snugly covering the rim with a strip of Billroth-battist.

In these cases the hyperemic treatment is, naturally, but a part of the regular treatment, but it is a very essential part. Its use forbids an immovable plaster jacket in the beginning; if such be deemed necessary later on, it will have to have a large window cut out.

Surgeons will act wisely by adding the regular daily use of the lung-suction mask (see page 158) to the protracted treatment of patients afflicted with Pott's or hip-joint disease or other chronic bone troubles.

Tuberculosis of the Ilio-sacral Joint and of the Os Sacrum.

The same method of treatment is to be employed in the serious cases of unilateral or bilateral tuberculous affection of the ilio-sacral joint* and of the intractable tuberculosis of the os sacrum. If such patients have the means, they should go to the mountains, accompanied by a competent and thoroughly instructed nurse, and remain there under medical superintendence. (Figs. 77 and 78.)

It is to be hoped that sanatoria for the poor will soon find sufficient financial support to enable them to open their doors also to adult patients suffering from surgical tuberculosis, even if their trouble be complicated with sinus-formation.

* In unilateral disease of younger or middle-aged patients radical excision of this joint often gives good results.

A patient with this form of tuberculosis may be up and about, if he wear a movable corset and use crutches to support the weight of the upper part of the body.

Contraindication to the Use of Hyperemia in the Treatment of Tuberculous Joints.

One of the first questions that arise is, whether the treatment is applicable to *all* joints, excepting, of course, the hip-joint, which presents mechanical obstacles which, so

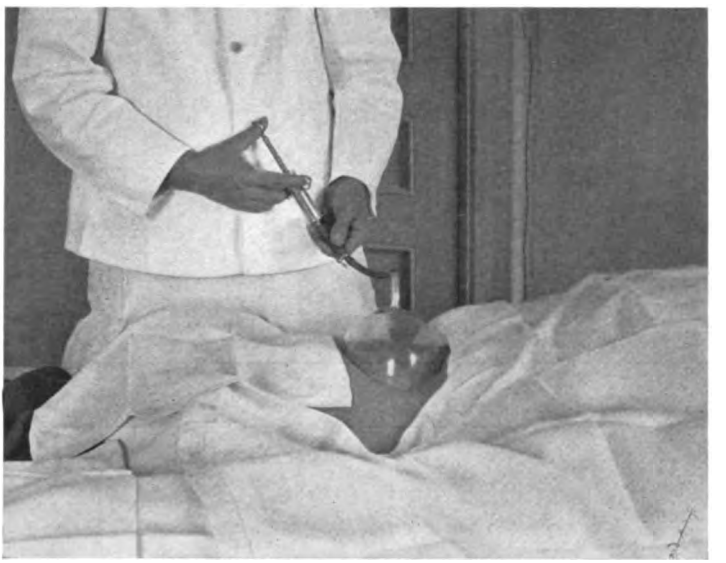

Fig. 77.—Shows the application at the moment when the attendant produces the local hyperemia by rarefying the air within the cup by means of a suction pump. The large cup covers the upper part of the sacral bone, the fifth and fourth lumbar vertebræ, and both ilio-sacral joints. (A cold abscess that had formed over the junction of the os ilii and sacrum on the left side, and was three times injected with a 5 per cent. sterilized emulsion of iodoform-glycerin, after the pus had been evacuated through a trocar, is definitely closed.) In order to increase leukocytosis and improve the general condition of the blood, the patient uses the lung-suction mask twice a day for one hour for the last six months. (See page 158.)

far, have not been overcome. The answer is a negative one. There are exceptions, namely:

1. The purely hydropic forms of tuberculosis, principally in connection with the knee-joint, the so-called "synovitis

tuberculosa exsudativa." Experience has shown the old method of aspiration, followed by the injection of iodoform-glycerin, to be preferable.

2. In cases of which we know that the functional result cannot, in the end, be superior to that obtainable by resection in a much shorter time; *e. g.*, tuberculous fistulous knee affection with bony adhesions between the patella

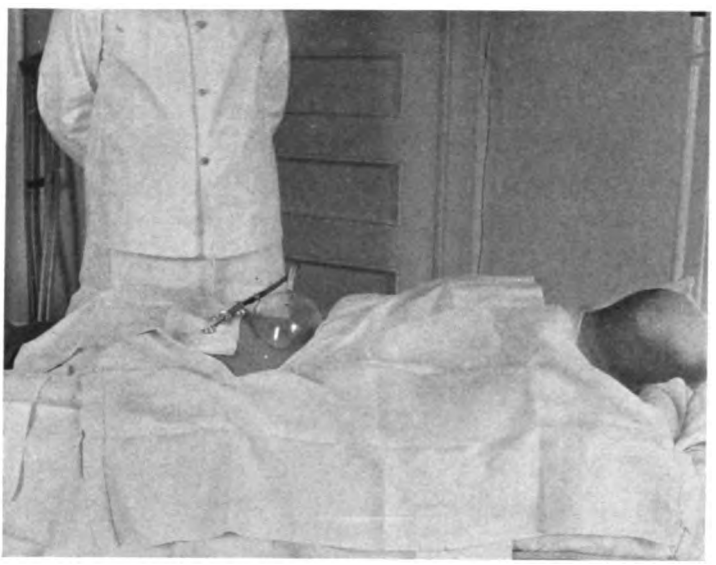

Fig. 78.—Demonstrates the cup in use. After the proper degree of negative pressure within the glass has been obtained, the suction pump may, of course, be detached.

and the femur, or subluxation of the tibia. Such a joint can never become sufficiently movable to give the patient a feeling of security as regards the use of the extremity. Here resection is clearly indicated.

Especially with reference to the knee, then, the surgeon must bear in mind that the conservative treatment, re-

quiring considerably more time, should not be employed except it promises a good functional result. A movable articulation being the prime advantage of the method, it should not be applied in cases in which this is not likely to be obtained. He may here often find the indication for resection, although it should be mentioned that resection is not a panacea either. Fistulous cases in particular often refuse to close. However, if, then, obstructive hyperemia either by means of the elastic bandage or suction cups be employed as an adjunct to resection, the trouble is usually overcome in a most gratifying manner.

With the ankle-joint, elbow, and wrist the case is different. Here we may expect a cure with a good functional result in about 75 per cent. of the cases, more or less, from the use of Bier's hyperemic treatment.

3. Complicating advanced pulmonary tuberculosis, or amyloid degeneration. Here amputation is indicated.

With the exception of these three classes of tuberculosis, the painless and conservative Bier treatment is indicated in almost every case of joint tuberculosis, even those of severe character.

Advanced age is no contraindication. There is no reason why old people should not as well benefit from Bier's beneficent procedure.

If no improvement is noted after a few weeks' faithful application of the method, resection or amputation is in order.

Ambulatory Treatment.

In the protracted treatment of tuberculous joint disease, either by bandage or suction glasses, the patient (or his relatives) should be taught to carry out the treatment himself. A few weeks' stay at the hospital usually suffices

for proper training in this direction. If the patient's attention is earnestly and repeatedly called to it, he will soon understand the importance of perfect cleanliness in dealing with sinuses.

Tuberculosis of the upper extremity is especially well adapted for dispensary practice. Only severe cases will need to go to a hospital for a longer or shorter period. They must, however, be cautioned to come for regular frequent revision, and to promptly report in the event of any aggravation of the trouble. The possible development of a cold abscess must be carefully watched for by the surgeon.

Adults with tuberculosis of the lower extremities ought to enter a hospital, at least for a time. As stated above, they need supporting splints after improvement has sufficiently advanced to allow them to be out of bed. It is important not to have these patients stay at the hospital any longer than is absolutely necessary, for they only fill our surgical wards with non-operative cases. Besides, the daily observation of these cases is rather tiresome in view of their slow progress. At the dispensaries, however, where the surgeon sees them only now and then, they will not so easily wear out his patience; the improvement during the longer intervals will be more evident; and last, but not least, the patients themselves are much better off away from the constant suggestion and association with disease as necessarily presented in the wards of our hospitals.

It seems hardly necessary to say that the hyperemic treatment must be continued *steadily*, until every trace of tuberculous inflammation has disappeared.

In cases in which the stiffness of the joints persists for months after a cure of the tuberculous process has been effected, a carefully conducted hot-air treatment may bring improvement.

Most remarkable results from Bier's hyperemic treatment have been observed in cases in which the method was applied at an early stage of the disease. It is evident, therefore, that an early diagnosis is of the utmost importance.

It is also essential that the general practitioner become thoroughly familiar with the procedure, for such cases may well remain under his observation. Early correct diagnosis and early application of hyperemic treatment may prevent much hardship among his patients.

Of course, obstructive hyperemia is not a panacea and should not be looked upon as such, but experience has shown that this conservative method is by far the best means at our disposal for the treatment of tuberculous joints. It makes for success in the simplest way, with a minimum of risk, and is connected with the least discomfort to the patient. It reduces his pains instead of adding to them; it heals without loss of function.

2. Tuberculosis in Various Localities.—Whereas tuberculous disease of the epiphysis of the bones with secondary joint infection is very prevalent, that of the diaphysis is extremely rare.

Spina Ventosa.

The bones furnishing the greatest contingent in this direction are the fingers and toes, as also metacarpal and metatarsal bones. If in these cases the diseased bones are removed, the fingers or toes are generally materially shortened; if nothing be done, the same result usually

sets in. Obstructive hyperemia by means of the elastic bandage, or suction glasses for the entire hand or foot, promises a more favorable outcome.

Cold abscesses in connection with this trouble are incised as usual, and then the hand or foot is subjected to suction. Tamponade is never used.

The surgeon who prefers to combine operative with Bier's treatment may open the diseased bone, clean out the tuberculous deposits and then start the hyperemic treatment,—again without employing tamponade. He will often hasten convalescence in this way. An *x*-ray photograph taken primarily is of great help in estimating the extent of the trouble.

Certainly, the necessity of transplanting a piece of the corticalis of the tibia with its periosteum into the defect resulting from radical operation for spina ventosa will rarely arise, either after hyperemic treatment alone or when used in conjunction with the cleaning out of the central osseal canal.

Abscesses Due to Tuberculous Glands.

Cold abscesses due to the softening form of tuberculous lymphadenitis, can rarely be attacked to advantage by radical operation. A small incision and the regular use of the suction glass for the production of the required hyperemia will hasten the breaking down of the remnant of the gland, which latter is then aspirated through the opening. Suction is continued until the fistula has closed. This treatment is of special value in cases in which the cosmetic result is a consideration. If suppurating glands in the upper part of the neck are thus treated, the elastic neck-band should be worn in addition during the course of the night, sometimes also part of the day.

Tuberculous glands that have no tendency to become softened, can be but little benefited by hyperemic treatment. They have to be extirpated.

Wandering Cold Abscesses.

Cold abscesses as we find them above or below Poupart's ligament, as a result of some tuberculous process of the ribs or vertebræ, should not be treated by incision and suction. *These it must be the surgeon's aim to keep closed.* Aspiration, followed by the injection of a sterilized five (or ten) per cent. iodoform-glycerin emulsion, should be done and repeated, if necessary. If perforation has already occurred at the time when the patient comes for treatment, suction hyperemia may prevent or improve a mixed infection.

Tuberculosis of the Testicle.

Tuberculosis of the testicle has also been successfully treated by hyperemic treatment.

The technique has been mentioned above. Obstructive hyperemia is produced with the help of a soft elastic tube (not of too small caliber) placed around the root of the scrotum and tied, or fastened by a small clamp. (Figs. 11 and 12.) A narrow pad of cotton batting should be slipped underneath the tube (Fig. 79), which is to remain in place for one to two hours twice a day, or longer, according to prescription. Here again the proper dosage best adapted to the case must be found by observation.

In unilateral affection the diseased testicle alone may be submitted to treatment. Usually, the patients prefer to have the tube encircle the entire basis of the scrotum, thus placing the diseased *and* healthy organ under hyperemia. No harm has ever resulted therefrom.

Cold abscesses are opened and subjected to suction, best while the tube is *not* in place. (Fig. 80.) With correct technique the pains are soon relieved; the infiltration of the epididymis *slowly* decreases or, if it breaks down, is

partly discharged into a cold abscess, and then through the sinus, that is to form after the abscess has been incised

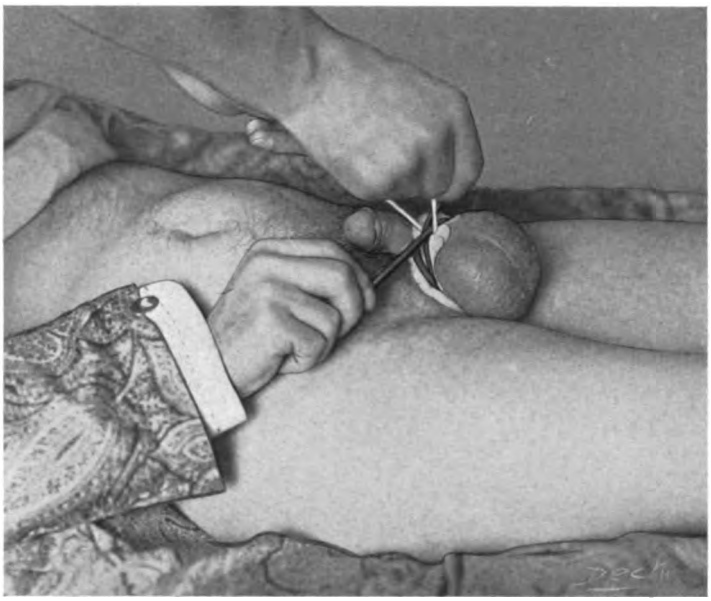

Fig. 79.—Shows the elastic tube in position, ready to be tied by the attendant, in a case of double tuberculous epididymitis. On the left side there is a very voluminous infiltration which embraces the testicle like a collarette. It broke down at the lower pole ten days after the hyperemic treatment was started. The sinus is regularly subjected to suction hyperemia, with good result. (Figs. 80 and 81.) Secretion is scant and serous, skin not undermined. Some cheesy material came away. On the right side there is but one circumscribed nodule of cherry's size, which has diminished but little during five months' treatment. It is gradually transformed into connective tissue. The vas deferens is not infiltrated on either side. Prostate and urinary system are not involved. It is a typical case of ascending tuberculosis. The patient, a man forty-nine years of age, is absolutely opposed to castration on either side, and is willing to submit to this local treatment, for a year or longer, if necessary, rather than undergo an operation.

and emptied. Aseptic treatment of such sinuses is, of course, strictly to be observed. Patients learn easily to apply the tube themselves. Their own feeling will be the

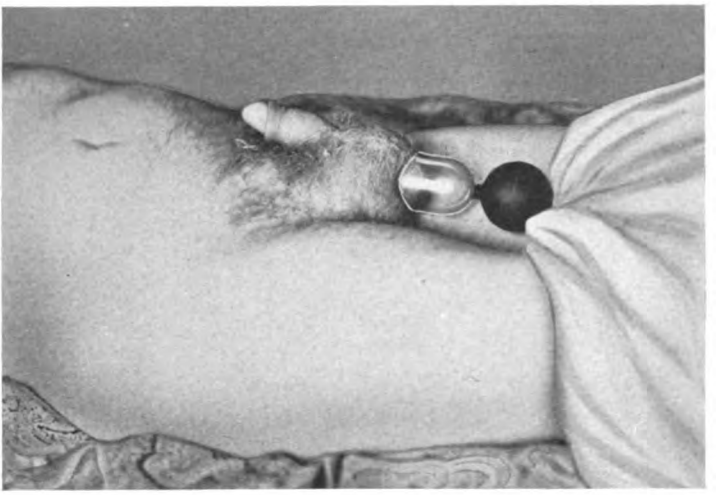

Fig. 80.—For description see legend of Fig. 79.

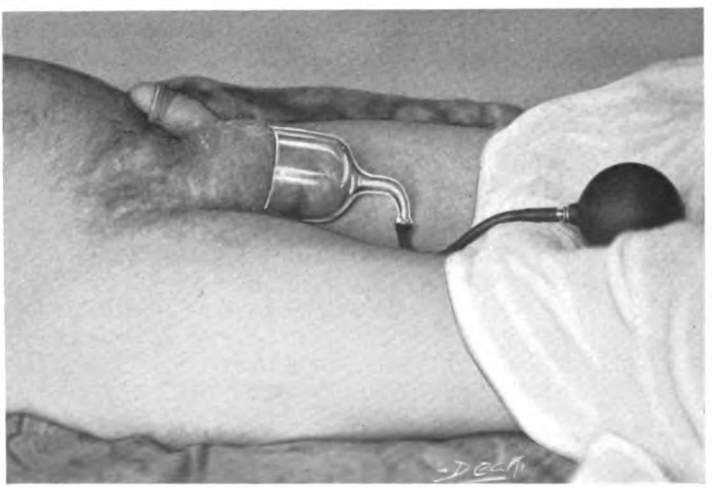

Fig. 81.—For details see legend of Fig. 79.

best guide in indicating the degree of firmness with which it should be applied. If suction cups are to be used, these, too, can be well handled by the patient himself. Those who can afford it, may employ a special nurse for this purpose. (Fig. 81.)

Between treatments a suspensory bandage is worn. In the presence of a sinus, a piece of sterile gauze, thus:

must first cover the scrotum.

It should be stated that the swelling of the epididymis rarely disappears. Infiltrated nodules persist; but these are made up by connective tissue and do no longer contain tubercles. It has been seen that the persistence of these nodules, even as far as their size is concerned, does not disprove the success of the treatment, so long as the pains disappear and the progress of the disease is checked.

In these cases again the hyperemic treatment yields best results if applied in the beginning of the disease. It is indicated if both sides are affected, or if one testicle has already been removed.

Bilateral castration should always be the last resort, unless the patient himself prefer an operation to a long-continued treatment which, of course, does not absolutely guarantee a cure. In such a case resection of the epididymis, though doubtful in its effect and value, might first be undertaken. For a secondary infection of the testicle proper, as found in a number of cases in the course of the operation by orchidotomy, hyperemic treatment might then be tried.

Before total emasculation is carried out, the patient and his relatives should be made aware of the importance

of internal testicular secretion; they should be told that mental disturbance of some kind or other not infrequently follows this procedure.

Unilateral orchidectomy, however, seems advisable in all cases in which only one epididymis is the seat of an *advanced* suppurating tuberculous infection, so that the mate might be saved.

It is self-understood, that our advice to the patient must be based upon a most careful diagnosis of the condition of the genito-urinary tract. If tuberculosis of the epididymis is but a part of a more generalized tuberculous affection, involving vas deferens, seminal vesicles and prostate, or kidney and bladder, neither operative nor hyperemic treatment can hold out much hope for extensive improvement. Still, we shall probably feel inclined to put such a patient under good hygienic régime, as far as financial circumstances permit, and combine with this an attempt at preserving the diseased generative glands.

Tuberculosis of Tendon-sheaths and Synovial Tendon Sacs (Tuberculous Hygroma).

Tuberculosis of the tendon-sheaths of forearm and foot, as also of synovial sacs (hygroma), is treated with the elastic bandage in the same manner as tuberculous joints. The serous exudation, so often present and usually somewhat turbid, is first removed by puncture. The so-called "rice-corpuscles," found in the hour-glass-shaped synovial sac in the palm of the hand and under the volar carpal ligament, must also be primarily removed. They are never preserved under conservative treatment. The sac, therefore, is opened by a small incision, best in the palm of the hand, and, after its contents are thoroughly evacuated by massaging and gently squeezing the sac over toward the wound, is either closed again by suture, or,

if one is not sure that all the corpuscles have been removed, is left open and dressed. Then artificial hyperemia is started and given twice a day for one to two hours. Here again attention must be called to the fact that this conservative procedure has to be continued for a long period of time. However, the results often are ideal. If, on the other hand, it be a question of saving time, operation should be done; and we know that radical extirpation of the fungous synovial sheaths with immediate suture of the wound, under artificial anemia, is often followed by primary union, with excellent preservation of function, although these satisfactory results are less frequently encountered in tuberculous affections of the flexor, than of the extensor sheaths.

Incomplete Fistula in Ano.

In cases of external incomplete fistula in ano, consecutive to the perforation or an incision of a tuberculous abscess, in which operation is refused, the suction glasses may well be tried. Application: twice per day for forty-five minutes. Also the very minute communication with the rectum that is usually present in these cases, although the probe refuses to pass, can be definitely closed if the treatment be continued long enough.

Between the treatments an ointment dressing covers the wound. Sitz-baths are ordered.

It need hardly be stated that in cases of complete anal fistula hyperemic treatment should not be attempted.

Tuberculosis of the Peritoneum.

In view of what we have learned about hyperemia, it would seem that the curative effect of abdominal section in exudative tubercular peritonitis, the cause of which has been so long disputed, is due, principally, to the hyperemia following the evacuation of the fluid present. This reasoning would also explain the fact that the hyperplastic types, in which the vessels cannot dilate to any consider-

able extent, rarely respond to this procedure. Remarkable, of course, remains the circumstance, that a single induction of a hyperemia should prove curative. Yet, as observation has shown over and over again, immediate closure of the wound after abdominal section is usually followed by a permanent cure. Of course, we are unable to tell how long the ensuing hyperemia lasts.

In closing the chapter on infectious inflammations, it would seem proper to here repeat the principal features of hyperemia in general, viz.:

The painlessness of its application, no matter which form of hyperemia may be employed;

Its power of promptly relieving already present pain; and, if it come to operative intervention:

The good cosmetic result generally obtained under its use; and, last, but not least,

Its great tendency to preserve the function of the affected part.

SYPHILIS.

It has been interesting to note that artificial hyperemia is void of any special value in the treatment of syphilitic lesions. Evidently, the pathologic changes brought about in the body by the spirochæta pallida (Schaudinn) do not react to this mode of attack. This lack of response to hyperemia is so definite that it has been suggested that the negative or positive result of Bier's treatment might become another decisive factor in the case of a differential diagnosis. However, this is merely a suggestion, and further investigations will have to be made before any conclusions can be drawn. Perhaps it will be shown that hyperemic treatment in combination with the usual antisyphilitic régime will more speedily bring into subjection and to absorption such syphilitic lesions of the third stage as have

proven very obstinate to any kind of treatment (*e. g.*, specific osteoperiostitis of the tibia, syphilis of the brain, etc.), as well as hasten recovery in those cases that are known to yield only to prolonged mercurial and iodine medication.

For the specific ulcer of the leg this proof has already been rendered. Obstructive hyperemia with the elastic bandage around the thigh will often help along in a surprising manner the cleansing of sloughing ulcerations and their subsequent cicatrization.

CHRONIC INFLAMMATIONS NOT DUE TO SPECIFIC BACTERIA.

CHRONIC ARTHRITIS (CHRONIC ARTICULAR RHEUMATISM); ARTHRITIS DEFORMANS; ARTHRITIS URICA (GOUT). APPENDIX: JOINT STIFFNESS, FOLLOWING INFLAMMATION.

The nomenclature of these troubles is very much mixed up. Still, the above subdivision would seem permissible in the face of clinical experience.

Chronic Arthritis (Chronic Articular Rheumatism).

Active hyperemia by means of hot air is *the* treatment for this trouble. It has a powerful influence in causing inflammatory exudates to become absorbed. However, it greatly taxes the patient's strength, at least in the severe cases with involvement of many joints. Here, then, the physician must proceed very cautiously. Only the joints principally affected should be exposed to the hot air, one or two joints of the upper extremities in the morning and the same number of joints of the lower extremities in the afternoon. Time: one-half to one hour daily. Degree: as hot as can be conveniently borne. Dosage: to be adapted to the patient's physical endurance.

Incidentally, the interesting observation has been made that by thus treating the mainly affected joints other joints also improve.

The treatment is continued until a cure is obtained.

It should be mentioned that also obstructive hyperemia (with the elastic bandage) may prove of great benefit in this affection, particularly in combating the acute exacerbations which patients of this kind so often are subject to. Especially true is this of the cases in which the smaller joints are involved; *e. g.*, elbow, wrist and finger articulations. The bandage is applied from ten to eleven hours twice per day, with the usual one to two hours' intermission. The resulting edema should be reduced by rubbing and elevation. Scientific massage is not required for this purpose. The edema, of course, cannot be removed by passive hyperemia; this only improves the stiffened condition. But the elastic compression must be strong enough to produce this very edema in the parts below; otherwise it is of little benefit.

In some cases, particularly knee cases, passive hyperemia has shown such remarkably good results that some surgeons have come to consider the majority of cases of chronic articular rheumatism to be dependent upon a former gonorrheal infection of mild type. In fact, the disease sometimes develops as a result of a previous acute gonorrheic inflammation that was successfully overcome.

Patients suffering from chronic rheumatism of the shoulder may be greatly benefited by the systematic use of the hot-air box for the shoulder, as shown in Figs. 55 and 56. Many confirmed rheumatics procure such an apparatus for their own private use and succeed in prevent-

ing the full development of a recurring attack by promptly employing this apparatus.

Arthritis deformans has been treated with hot air with varying success. Pronounced destruction of bone and cartilage can, of course, not be rectified by it. In such cases one has to be contented with alleviating the pain and retarding the progress of the trouble. Active motion and the use of the limbs should be insisted upon. Plaster splints and orthopedic machines that put the joint at rest are to be discarded. **Arthritis Deformans.**

Attacks of gout yield nicely to passive hyperemia. The bandage is applied for two to three hours twice per day. In the interval alternating hot and cold local applications are said to be of benefit. **Arthritis Urica (Gout).**

It is interesting to note that inflammations caused by uric acid yield to the influence of artificial hyperemia as readily as those produced by bacterial poisons. The cause of the inflammation seems to be immaterial.

APPENDIX.

JOINT STIFFNESS FOLLOWING INFLAMMATION.

The doctor who has earnestly worked for maintenance of function in treating traumatically inflamed joints, as described above, should not stop half-way. He should try to overcome the last vestige of stiffness by prescribing and superintending active hyperemia by means of hot air and the orthopedic suction apparatus mentioned above.

It is evident that this can be done satisfactorily in hospitals and clinics only, where these apparatus are on hand and their working is thoroughly understood.

One word still with reference to the "brisement forcé," **Brisement Forcé.**

which seems to be in favor with many physicians. Experience has shown that while mobility is temporarily increased thereby, the blood exudation, caused, later increases the ankylosis owing to the tight new formation of connective tissue. This procedure is *never practised* in connection with hyperemic treatment.

VARIOUS SURGICAL DISEASES THAT ARE BENEFITED BY BIER'S TREATMENT.

Diseases Belonging to the Domain of Orthopedic Surgery: Inflammatory Flat Foot and Scoliosis.

Inflammatory Flat Foot.

The pathologic changes of the small joints of the tarsus, found in the so-called "inflammatory flat foot," respond most favorably to the hot-air treatment. The resulting marked decrease in sensitiveness soon renders possible active and passive exercises. Better headway is generally made by this procedure than by the forced intermittent reposition with fixation, which may insure the position, but does not relieve the pain and stiffness.

Scoliosis.

The same favorable results have been obtained with the method in the treatment of lateral curvature of the spine. Fig. 82 illustrates a large hot-air chair designed for the use of three persons of various size. According to the directions of Klapp, the entire spinal column is exposed to hot air, with the result that the multiple stiffened articulations of the scoliotic spine gradually become mobilized; this mobility is increased by immediately following up the treatment by orthopedic gymnastic exercises.

Varicose Veins; Ulcerations of the Leg.

Varicose Veins.

Varicose veins and their sequelæ have been found amenable to active (arterial) hyperemia only. The increased

circulation absorbs the chronic edema and gradually overcomes the obstacles to proper circulation due to the thrombosed veins. The treatment is especially beneficial in cases showing a diffuse ectasis of the smaller veins of the skin with the subsequent bluish, edematous swelling of the limb and foot; as also in cases of threatening perforation and ulcer formation.

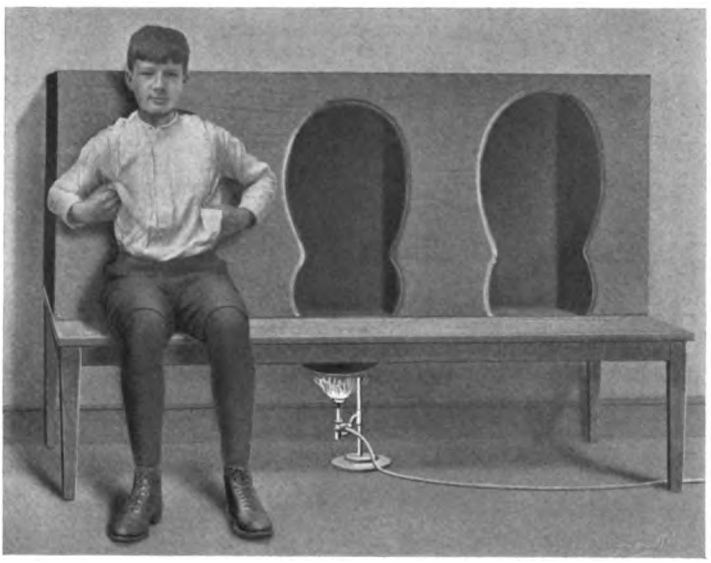

Fig. 82.—Illustrates a hot-air box in which a number of scoliotic patients can be simultaneously treated in order to mobilize the stiffened vertebral joints, preparatory to the gymnastic exercises.

Time of exposure and degree of heat, moderate, about one-half hour daily at 160° F. (70° C.). Burns must be carefully avoided, as they would only mean an additional cause for ulceration.

It is hardly necessary to say that the value of resection or extirpation of the saphenous vein, with or without

Schede's operation, will remain unimpaired. They are indicated, as before, in cases of the typical varicose enlargement of the trunk of the vena saphena.

Recently Thrombosed Veins.

A recent thrombosis constitutes a strict contra-indication to hot-air treatment, since the artificially increased circulation would be apt to loosen the thrombus and give rise to the always threatening pulmonary embolism. With perfected organization of the thrombus, the danger decreases.

The same holds good in thrombosis of the femoral vein, following typhoid and other infectious diseases. Here months must pass before hot-air treatment may be called into action to assist in overcoming the troublesome edema of the extremity.

Ulcers of the Leg.

Ulcers of the leg yield nicely to moderate baking, for one and one-half hours per day. Their base is thereby quickly cleansed and cicatrization hastened. The method certainly represents a valuable addition to our resources in the treatment of these distressing cases that often crowd our wards and tax to the utmost the patience of both physician and patient. Rest in bed, with proper dressings, and elastic compression over the wound will assist in hastening the course.

We would here again call attention to the wisdom of trying obstructive hyperemia in cases of chronic syphilitic ulcer of the leg, in the absence of varicose veins, and also in cases of large obstinate ulcer of the extremity due to traumatism. Often these latter will heal to a certain extent when contraction with cicatrization stops in spite of various kinds of stimulating dressings. Only Thiersch's skin grafting or autoplasty are thus far known to have

brought them to a close. Passive hyperemia by means of the elastic bandage (perhaps also the suction glass) offers a fair chance of healing them without operation.

SENILE AND DIABETIC GANGRENE; GANGRENE DUE TO EMBOLISM OF THE MAIN ARTERY.

Senile and Diabetic Gangrene; Gangrene Due to Embolism of the Main Artery.

It is very tempting to locally increase the quantity of the circulating blood in cases of threatening gangrene due to arteriosclerosis, diabetes, or embolic occlusion of the main trunk of the extremity as it is sometimes seen to follow serious cases of pneumonia, etc., complicated with endocarditis. The efficacy of such procedure has been practically demonstrated. But strict supervision and careful handling of such cases are absolute requisites to insure success, since the reduced sensitiveness of the parts and sluggish circulation both favor burns.

Ten minutes' exposure to hot air twice per day, at 140° F. (60° C.), is ample for the beginning. With the return of warmth, etc., to the extremity, the time and degree of heat may be slowly increased up to 190° to 195° F. (90° C.).

Should the same therapy employed in an actually present gangrene, succeed in checking its progress, a continuation of the same would probably favor demarcation and separation of the necrosed part, provided amputation is not indicated.

In the absence of facilities for hot-air treatment gentle obstructive hyperemia, for two hours twice per day, may answer the same purpose. The bandage should be applied over an area where the femoral or brachial artery shows good pulsation, *not* below the middle of the thigh or arm, and it should always wander up and down the extremity,

as previously explained. Great care is needed in feeble diabetics, as pressure gangrene is apt to appear where the bandage has been in place.

FROST BITES.

Frost Bites.

Hot-air treatment has proved of great benefit in frost bites. Acute and chronic cases respond equally well to it. The cyanosis of the parts involved, the troublesome paresthesias and ulcers disappear quickly under the increased arterial circulation. An ointment dressing should cover the ulcers in the interval. Passive hyperemia, too, has shown good results in these cases.

Intraperitoneal Adhesions.

To prevent post-operative intraperitoneal adhesions it has been proposed to submit the patient's abdominal region to hot-air treatment soon after the operation.

TUMORS.

It is self-understood that tests with artificial hyperemia in malignant disease are to be made only in inoperable cases.

The elastic bandage which has been tried in cases of sarcoma, has given unsatisfactory results; the increased amount of blood seemed to favor rapid proliferation of the tumor.

However, the results from hyperemia by means of suction glasses have been rather encouraging. In ten cases of inoperable sarcoma and carcinoma in which this treatment has been employed ("Münchener med. Wochenschr.," No. 43, p. 21 to 24, 1907) diminution in the size of the tumor was observed in every instance, and the longer the treatment had been applied the more pronounced was the shrinkage. Microscopic examination of particles of the tumors excised after treatment showed the cancer cells to have been partly replaced by granulation tissue.

One case, a young man twenty years of age with inoperable, undoubted sarcoma of the shoulder, was discharged with no visible trace of the disease left, after a prolonged course of suction hyperemia, and without the tumor's having undergone softening and perforation.

In view of the sad prognosis of these cases of inoperable malignant disease, the method seems worthy of further trial.

BIER'S HYPEREMIA IN MEDICINE AND THE SPECIALTIES.

With the value of artificial hyperemia in the treatment of many surgical diseases established beyond doubt, it was but natural that a therapeutic agent of such far-reaching influence should have been tried also in diseases belonging to the domain of internal medicine and the specialties. In many respects Bier himself was again the pathfinder also along these lines. What has been accomplished thus far is certainly of sufficient interest to serve as an incentive to further investigation.

The authors of this book consider it their duty to give a short account of what has been done in these branches, indicating by the smaller type used, that further careful study and observation are needed to substantiate the experiences thus far reported.

CHAPTER V.

HYPEREMIC TREATMENT IN MEDICINE.

Acute Articular Rheumatism.

Acute articular rheumatism, being similar in its manifestations to the gonorrheic affection, like the latter responds well to artificial hyperemia by means of the elastic bandage. Bier was the first to try his method in this class of cases.

Fairly satisfactory results have been obtained by him as well as others under adherence to the following rules:

1. The bandage is applied sufficiently tight to produce redness and increased warmth of the part treated, but must not cause edema.

2. Time of application: twice per day for two to three hours.

The symptoms disappear in the following order: First, the pain ceases; then the power of motion shows improvement, and lastly follows reduction of swelling and fever; that is to say, the most serious symptoms yield first.

If the treatment alone does not relieve the symptoms within, say, a week's time, salicylates should be given in addition, but in smaller doses than are usually administered in these cases. No harm has resulted from giving the salicylates at once.

It may be taken for granted that cases that do not respond to hyperemia would, likewise, not have yielded to salicylates.

Hyperemia should *always* be tried *first* in these cases,

unless the patient objects to this mode of treatment or the spine or hip-joint be the seat of the trouble, in which event hyperemia can be induced with difficulty only, if at all.

Cerebrospinal Meningitis.

Hyperemic treatment has been tried in the various forms of cerebrospinal meningitis, suppurative, tuberculous and epidemic.

The *immediate* application of the neck band has been noted to overcome symptoms of undoubted beginning inflammation of the meninges, complicating suppurative processes of the skull or face.

Passive hyperemia is not known to have shown any favorable influence in cases of tuberculous meningitis. But in the epidemic form noteworthy results have been obtained.

Bier suggested some time ago that head hyperemia plus lumbar puncture might be worthy of trial, inasmuch as it is his opinion that lumbar puncture not only reduces the intracerebral pressure, but also evokes a hyperemia of the meninges, same as puncture of a pleuritic effusion causes hyperemia of the pleura and that of an ascites hyperemia of the peritoneum.

Five cases of epidemic cerebrospinal meningitis treated by artificial hyperemia of the head plus lumbar puncture have been recently reported, with four cures; the fifth, a child of two years, at the end of the ninth week, when almost cured, developed symptoms of acute hydrocephalus, to which complication it quickly succumbed.

This favorable experience with so treacherous a disease should invite further trials.

Diphtheria.

The result in 36 cases of diphtheria treated with hyperemia of the head has been: more rapid loosening of the diphtheritic membranes, no descent of the process into the larynx, and no subsequent complications.

It is self-understood that hyperemic treatment does not constitute a contraindication to the employment of antidiphtheritic serum.

Pulmonary Tuberculosis

The idea of making use of an artificially increased volume of blood for the purpose of combating surgical tuberculosis was conceived by Bier as a result of his studies of the observations made by other authors, almost a century ago; namely, that tuberculous foci are found with great frequency in the lungs of individuals with heart lesions, causing an *anemic* condition of the lungs, while in the presence of a *hyperemic* state of the latter they are rarely found.

Farre and Travers (1815), Lewis (1826), and Frerichs (1853) have shown by numerous postmortem examinations that patients afflicted with stenosis of the pulmonary artery are very liable to be stricken with phthisis, whereas Rokitansky, in 1838, proved, on basis of his large dissection material at the Vienna hospitals, that tuberculosis of the lungs is very rarely found in combination with venous pulmonary hyperemia such as is observed in cases of valvular disease of the heart or deviations of the spinal column. In fact, he could show that tuberculous foci heal and show all the characteristics of cicatrization in the presence of such heart lesions. There are many other interesting proofs of the fact that *the amount of blood within the lungs determines the degree of liability of the patient to pulmonary tuberculosis.*

It seems logical to assume that, if nature can bring to cicatrization tuberculous foci in the lungs by reason of a hyperemia existing as a result of circulatory disturbances, it must be possible to obtain the same result by means of a hyperemia artificially induced.

The point, then, was to find the means of reliably producing such artificial hyperemia.

Bier's own original idea (1903) was to make patients afflicted with pulmonary tuberculosis inhale through the nostrils under slight compression of the same by the fingers, allowing them unobstructed exhalation through the mouth. (He also tried to produce passive hyperemia of the apices of the lungs by glass suction apparatus of various sizes, but this did not yet prove satisfactory.)

We know that the respiratory distention and contraction of the thorax is an automatic physiologic act. Now, if we prevent the natural, easy inflation of the elastic lung tissue, as it occurs under ordinary circumstances, when the thorax expands during the act of inspiration, the air within the lungs becomes rarefied and blood is aspirated from the heart. In other words, we produce an artificial hyperemia of the lungs by suction.

In a rather crude way, obstructed inspiration could also be arranged for by placing, *e. g.*, eye-glasses or some kind of a clamp upon the nostrils, regulating the degree of obstruction by placing same higher or lower; or small perforated corks might be placed within the nostrils, the degree of obstruction to be controlled by the size of the perforations. Empty spools with holes of various caliber, put into the mouth and held by the teeth, the lips closing air-tight around the spool, will obstruct mouth inspiration, while expiration can then take place freely through the angles of the mouth, alongside the spool, the lips releasing their hold on the same. This latter device will be found rather annoying to the patient, as it will dry out the mouth and respiratory passages.

An exact regulation of the degree of obstruction to inspiration can be obtained with the so-called "lung suction mask," devised by Kuhn. Made of thin celluloid, the mask has the shape of the mouth-pieces used to cover

the patient's face when administering one of the volatile drugs for general anesthesia. (Fig. 83.) The edges here, too, are protected by rubber tubing which is filled with

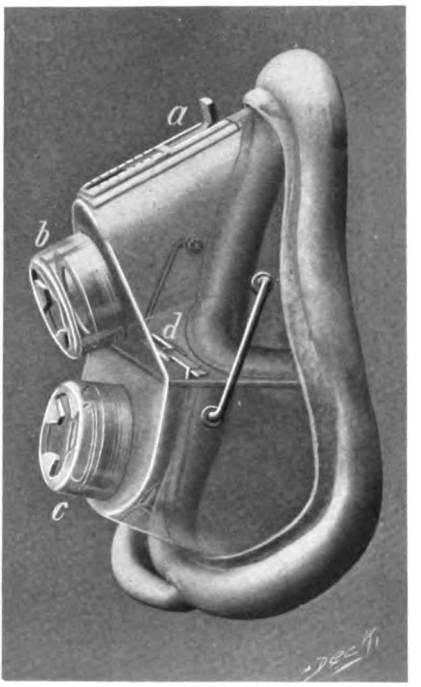

Fig. 83.—Kuhn's lung suction mask for the hyperemic treatment of pulmonary tuberculosis. *a*, Slide; most important part, inasmuch as it regulates the obstruction to inspiration. *d*, Slide, situated within the mask, shutting off communication between the two chambers for mouth and nose. It is always kept closed, except when the patient has a cold, or is unable, for other reasons, to inhale through the nose, as, *e. g.*, in the presence of polypi. *b* and *c* are the valves which serve for expiration and prevent additional inspiration. These are the same as those usually found in our narcotising apparatus. This model of a mask is very practical, inasmuch as it can be used for the face of any adult, but it is made of celluloid, a highly combustible material, and cannot be sterilized by boiling, drawbacks which call for correction. An attempt to manufacture the mask in the United States has, thus far, not been crowned by success, there being a patent on the device. A mask of smaller size is made for children.

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air to avoid pressure. The mask is divided transversely by means of a celluloid wall the border of which rests on the upper lip and is, likewise, provided with an inflatable pad. In this way we have two separate compartments, one for the nose and one for the mouth, there being no communication except by a slide covering a narrow slit in the transverse dividing wall. (Fig. 83, *d*.)

This slit is opened only if nasal respiration is temporarily or permanently interfered with. The mask is placed over the nose and mouth of the patient and held in place by two elastic straps passing below the ears and fastened in the back by means of a buckle. (Fig. 84.) Another slide, attached to the outer side of the nasal section of the mask, controls the degree of obstruction desired. (Fig. 83, *a*.) This is the principal part of the device, inasmuch as by it we regulate at will and by degrees the amount of obstruction to the passage of air into the alveoli of the lungs. It has a scale of 6°, and covers a slit somewhat less than one-sixteenth of an inch (one millimeter) wide and somewhat longer than the one in the partition membrane between mouth and nose cavity. Two caps, that can be screwed off, each embracing a small celluloid plate, form the valve for expiration, same as we find this in the ordinary narcosis inhalers. (Fig. 83, *b* and *c*.)

If the regulating slide be entirely open, the patient can inhale quite some air, but naturally never as much as without the mask.

Inspiration is done through the nose and expiration either through the mouth alone or through both mouth and nose.

Of course, if desired, the valve over the mouth section of the mask could be entirely removed. But this should be done in the case of intelligent patients only, as then special attention has to be paid to the act of respiration. During sleep this valve, too, should always be in place.

The mask is worn in the beginning two to three times a day for fifteen minutes; later, the time is slowly increased to one hour two to three times per day. The primary unpleasant effects from wearing the mask, consisting in headache and dizziness, will not last, but disappear quickly as the applications are continued.

While using the mask the patient would best rest on

Fig. 84.—Patient resting, with the lung-suction mask in position. He will learn to use it for one hour in the morning and one hour at night which is ample for the average case and does not interfere with the patient's business. The couch, of course, should be placed as near an open window as possible.

an easy chair on the piazza or on a lounge near an open window. (Fig. 84.)

Disinfection is done (with the rubber straps unbuckled) in a *cold* three per cent. solution of lysol or carbolic acid. Afterward the mask is rinsed in cold water in order to get rid of the odor of these disinfectants. It is advisable to remove the two caps on top of the mask often and clean

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and dry the small celluloid plates. They are apt to become sticky, but proper care must be taken to always have them work easily. It must be borne in mind that celluloid is a very combustible material and cannot be disinfected by boiling.

These two drawbacks still remain to be overcome.*

The use of the mask is not known to have done harm. All of the 75 cases, in which the mask is so far reported to have been used, were benefited. No deleterious effects of any kind were observed.

The principal effect to be obtained by the mask is twofold:

1. The healing of the tuberculous foci within the lungs by reason of the hyperemia produced.

2. The increase of the red and white blood corpuscles as well as of hemoglobin in the blood.

So far clinical observation and investigation have shown:

1. That the beneficial influence of the mask is greatest in cases of *incipient* pulmonary tuberculosis, or, better still, when used as a prophylactic.

2. That also advanced cases are greatly benefited by it, *as long as chronic toxemia and pronounced weakness of the heart do not render impossible any kind of improvement.*

3. That the risk of hemorrhage from the lungs does not forbid its use; on the contrary, there seems to be less liability to hemorrhage, since the granulations in the lung tissue apparently get stronger under the application of the mask, same as we observe this in granulations on the surface of the body, while under hyperemic treatment.

4. That by artificially reducing respiratory expansion the lungs are placed at rest, an important point in the treatment of pulmonary tuberculosis, which has lately been emphasized by various authors.

* There is a United States patent upon the mask; the same, however, covers only the *manner of construction*, not the *idea* of obstructed inspiration and free exhalation.

5. That postmortem observation of the lungs of a patient who died of chronic intestinal tuberculosis and in whom the mask had been used for several months, has shown the foci isolated and surrounded by a mass of new-formed connective tissue, the latter being in the stage of cicatrization. Further observations of pathologists will be received with great interest.

6. That, on account of the larger quantity of blood being aspirated into the lungs, more oxygen enters the circulation; furthermore, that in consequence of the resistance offered to inspiration, the entire system of respiratory muscles is strengthened, on the basis of the idea underlying the well-known "Swedish movements" method.

7. That by thus improving the constituency of the blood, the use of the mask not only incidentally improves the usual anemia of phthisical patients, but promises to become one of the most powerful physical aids, so far known to us, in our fight against ordinary anemia.

8. That, according to the degree of obstruction to inspiration arranged for, the mask produces the effect of various high altitudes on the general system, that is to say, it rapidly increases the number of red and white blood corpuscles, of the latter especially the polynuclear neutrophiles, and the percentage of hemoglobin. This is produced by the irritating effect of the condition of reduced tension of oxygen in the blood on the blood-producing tissues of the body, principally on the bone-marrow.

Inasmuch as the increase of the blood elements begins very early, one hour after applying the mask, it will be interesting to watch whether this obstructed inspiration might not be used to advantage in surgical patients, especially after abdominal operations, to produce artificial leucocytosis.

9. That the mask incidentally has proved of great

benefit in relieving the pulmonary circulation in cases of advanced valvular disease of the heart, as also in cases of obstinate asthma and delayed resolution after pneumonia.

This physical treatment of pulmonary tuberculosis will, of course, not do away with the well-tried and time-honored treatment by means of tuberculin,* pure air, rest, forced nutrition, proper drugs, etc.

It is but another, though *most important link* in the chain of our therapeutic resources in the fight against and probable ultimate conquest of this scourge of mankind.

It increases the natural protecting forces of the organism, by means of strengthening the normal functions of the body.

It will prove to be of especial value in dispensary practice and in the treatment of such phthisical patients as are not endowed with the riches of this world and cannot afford to leave their homes and their families.

Bone-metastasis Following Typhoid.

That osteoperiostitis, due to the metastatic invasion of the typhoid bacillus, can be nicely and promptly overcome by obstructive hyperemia has been repeatedly seen by Bier. The advantages of possibly avoiding operative work in these reduced patients are obvious. Further reports on this subject must be looked for with interest.

Lumbago.

The acute rheumatic affection of the sheaths of the lumbar muscles (lumbago) yields very satisfactorily to hyperemic treatment. Cupping has been employed for ages, but the hot-air hyperemia lately applied has given better results. For this purpose a special chair has been constructed, similar to the Morris chair. (Fig. 85.) The movable back rest is provided with a cut-out of sufficient size to receive the patient's back, behind which a

* The effect of tuberculin injections in phthisical patients will probably be increased by artificial hyperemia of the lungs.

hot-air box is placed, heated in the manner previously described. The patients highly praise the comfort afforded by this chair no less than the rapid improvement of their trouble.

Sea-sickness.

Also to overcome this much-dreaded annoyance to the seafaring public, hyperemia has been tried in various ways.

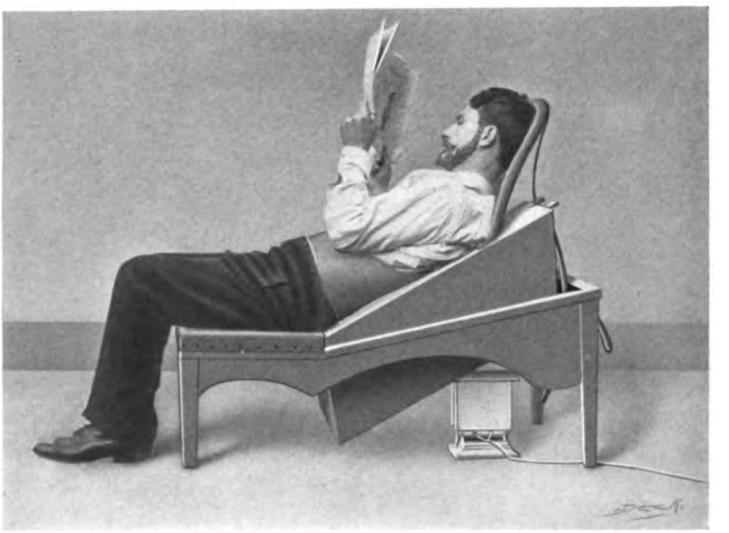

Fig. 85.—This figure illustrates the hot-air box treatment of the back, for lumbago. The patient's back, exposed, rests in the cut-out of the chair over which the hot-air box is applied. The latter is heated from below. The apparatus is constructed on the lines of a Morris chair.

The head hyperemia by means of the elastic band, has given best results. This would seem to furnish evidence in support of the opinion generally held that anemia of the brain caused by the motion of the boat is to a great extent responsible for the occurrence of the malady. It is known that many patients feel best in a horizontal posture, a

fact which further corroborates the correctness of this assumption.

Hyperemia by means of hot compresses to the head has also been advised, and a rather complicated apparatus, heated by electricity, has been designed for this purpose.

Naturally, there is no reason why other remedies should not be employed in addition.

CHAPTER VI.

HYPEREMIC TREATMENT IN GYNECOLOGY AND OBSTETRICS.

Chronic Para- and Peri-metritis.

Active hyperemia with the help of hot air has been extensively used in the treatment of pelvic exudates in cases of chronic para- and peri-metritis. Here, too, special boxes, arranged for the treatment of patients in the recumbent posture, have been built. The technique is the same as elsewhere. The necessary heat is provided by a gas-jet connected with a chimney, or by an electric stove, or by electric lamps attached within the box. The latter is similar in shape to the one used for the treatment of both hips. (See Fig. 60.)

Suction Cups in Gynecologic Therapy.

Of late the suction cup has also been introduced in gynecologic therapy. It is indicated in some diseases of the uterus and its immediate neighborhood. It has the shape of the well-known old-fashioned glass-tube speculum, but is made of plain glass. (Fig. 86.) Its one extremity is straight, not oblique, and slightly funnel shaped for receiving the cervix. The other end is closed; near this, a small tube is attached which connects with the rubber tube carrying the three-way cock. The air is rarefied by way of the suction-pump.

Two other styles of cups are in the market; one with a straight cylindric end (Fig. 87); the other, which is similar to the old-fashioned vaginal speculum, has a graded glass bulb, showing the amount of mucus or other uterine discharge brought out by the suction. The degree of hyperemia can be watched through the glass. (Fig. 88.)

Technique.

As regards the technique, the same general rules, given for the use of the suction cup, apply here. After five

minutes' suction, two to three minutes' rest, in order to give the artificially accumulated blood a chance to become distributed. Duration, in all about one-half hour per day. *Moderation cannot be too strongly emphasized. The application must be painless.*

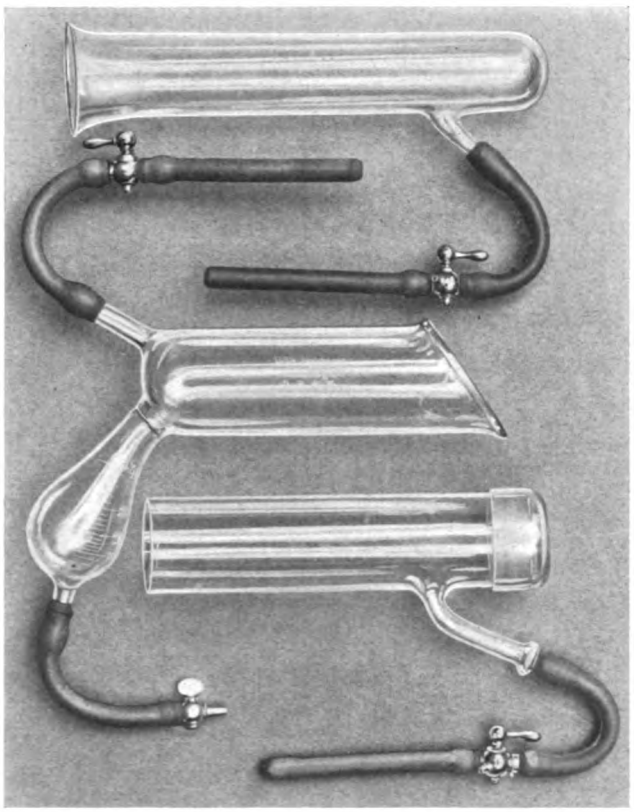

Fig. 86.

Fig. 88.

Fig. 87.

Figs. 86 to 88.—Suction glasses for the cervix uteri.

Gynecologists have formulated the following indications for hyperemic suction treatment: **Indications.**

In puerperal infection, to avoid general pyemia; for the betterment of amenorrhea; for the artificial interrup-

tion of pregnancy; to improve the drainage of mucous and purulent uterine discharge; in chronic metritis, with the exception of those cases that are complicated with a suppurative process of the adnexa; in ulcerations of the cervix.

It is impossible, at this date, to properly estimate the benefit to be derived from hyperemic treatment in these cases. Further experience and improved technique are needed.

Parametritis Posterior.

Recently favorable results have been reported from the use of a modified technique of the treatment in cases of chronic changes in the uterus and pelvic cellular tissue, described as parametritis posterior or parametritis chronica atrophicans. Here a high degree of suction is employed with the view of stretching and softening the uterine adhesive bands. The cervix is aspirated for some distance into the vaginal cup and discharges profusely under this negative pressure. The method has been called "suction massage." Only during the first sitting slight pains, similar in character to those of labor, are brought on. In the beginning the treatment is given daily, for about twenty minutes, with the usual interruptions; later on, less frequently. Many patients are reported to have been cured of their pains and troubles, and, incidentally, the fluor albus also is said to have disappeared.

All of the above clinical observations are of recent date. They have been mentioned here merely for the sake of completeness. But the outlook of bringing permanent relief by means of suction hyperemia and suction massage, to these sufferers from chronic formerly rather intractable diseases, seems bright.

Dysmenorrhea.

Attempts have been made to relieve dysmenorrheic troubles by applying the large suction glasses of Klapp to the breasts. (Figs. 23 and 24.) Application, once to twice fifteen minutes per day. A distinct sensation of distention of the breasts must be produced, but no pain. The treat-

ment is begun a few days before the expected menstruation and continued until it ceases. Effect, hyperemia of the breasts continues for hours and days; the advent of menstruation is retarded; the formerly prolonged flow lasts a shorter period and is connected with less pain.

The explanation of this phenomenon is to be found in the close connection between breast and uterus.

Puerperal Inflammation of the Knee.

With reference to the field of obstetrics, it is worthy of note that several cases of nonsuppurative, puerperal inflammation of the knee, which so often lead to permanent stiffness, have been cured by Bier by means of obstructive hyperemia, with very satisfactory function of the joint.

Puerperal Mastitis.

The treatment of puerperal mastitis with suction cups has been extensively discussed above (pages 90–94).

Deficient Lactation.

It was suggested, and has been found of benefit in practice, to apply the large suction glasses as used in cases of mastitis of the female breast, to increase the production of milk in nursing mothers, and to start anew the flow of milk that had stopped.

CHAPTER VII.

HYPEREMIC TREATMENT IN GENITO-URINARY SURGERY.

With regard to the value of the hyperemic treatment in genito-urinary surgery, the different authors are widely at variance. A great deal of work and careful observation by many clinicians are still required to clear up the atmosphere.

Acute Gonorrhea.

In the male sex the effect of obstructive hyperemia in an acute attack of this principal representative among

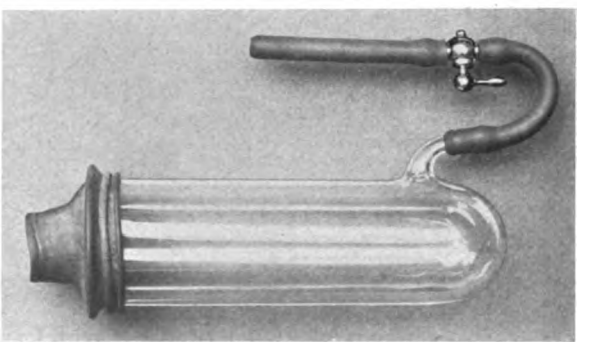

Fig. 89.—Suction glass for the pars pendula penis in case of gonorrhea.

the infections of the genital system, becomes somewhat problematical, owing to the difficulty of estimating clinically the line of advance of the gonococcus. But little work along these lines has been reported in the literature.

There is on the market a special suction glass for this purpose, similar to the one used for the fingers with paronychic infection, large enough to receive the pars pendula penis. (Fig. 89.) Perhaps a larger glass that would hold

in addition the scrotum plus testicles, and would, therefore, influence the urethral canal down to the cut-off muscle, would offer greater advantages. Surely, the other well-known methods of combating gonococcous invasion cannot be set aside.

Acute Gonorrheal Prostatitis and Seminal Vesiculitis.

If prostate and seminal vesicles have become involved, the difficulties with regard to the use of hyperemia increase. A metal tube with a window on the concave side, constructed after the model of the so-called rectal sound (Fig. 90), has been proposed for the induction of hyperemia in these organs; but the same needs improvement. The window is not large enough, and its edges are too sharp.

Fig. 90.—Suction apparatus for the prostate. The same can be used for the hyperemic treatment of tuberculous ulcerations at the neck and in the fundus of the bladder. It is introduced into the rectum or into the vagina; especially for the latter purpose, there is ample room for improvement.

A priori, a favorable influence upon acute gonorrheic prostatitis or spermatocystitis may with propriety be expected. But as stated above, no experience of real practical value has been reported thus far.

Acute Gonorrheal Epididymitis.

While some authors claim to have seen but little benefit in this class of cases from the use of obstructive hyperemia *i. e.*, with the tube around the base of the scrotum, others report excellent results from this procedure.

Suction glasses into which the testicles were aspirated have also been tried. (See Fig. 81.)

The tube is tied gently around the artificially formed scrotal pedicle. (Fig. 10.) If properly applied, prompt

subsidence of pain has been noted; in fact, the rapid decrease and final disappearance of the pains may be looked upon as proof of a correct technique. Hyperemia is employed for twenty hours per day, with four hours' intermission, during which latter the testicles are kept in an elevated position.

As soon as the pains have ceased and the intense tenderness has been overcome, the time of wearing the tube is greatly shortened. Brief periods of obstructive hyperemia, twice a day, plus hot-air douche, are ordered instead. The latter is applied directly against the scrotum, the patient being made to firmly press the testicle against the skin. In this way a depth effect is produced and the infiltration is lessened and slowly absorbed. This, if done in the acute stage, also tends to avert sterility, the frequent sequela of gonorrheal epididymitis. It is not absolutely necessary that these patients stay in bed.

Further careful studies ought to be made to determine the effect and value of the various forms of hyperemia in these cases. Such investigations should be carried on in clinics or wards, set aside for the treatment of venereal diseases, by men who have sufficient interest in the method to be willing to give the patience and time necessary for a faithful trial.

Acute Ascending Gonorrhea in the Female.

In the female sex early suction massage of the uterus by means of the special glass described above, after thorough irrigation and disinfection of the vagina, may occasionally prevent the spread of the process to tubes and ovaries and thus exert a favorable influence from a prophylactic standpoint.

Subacute Gonorrheal Urethritis, Prostatitis, Vesiculitis and Epididymitis.

In the *subacute* stage of gonorrheal urethritis in the male, as well as in subacute inflammations of the prostate, seminal vesicles and epididymis, artificial hyperemia will most probably be of benefit, particularly if it be combined with hot moist applications.

Great absorbing power being one of the chief characteristics of hyperemia, it is easy to understand that it will prove of value in causing to go down infiltrations in the corpora cavernosa, due to either purely gonorrheal or mixed infection, peri-urethral deposits, bartholinitis and inguinal adenitis. No doubt, more definite data will be brought out in the near future. (With reference to inguinal adenitis see page 87.)

Cavernitis and Periurethral Inflammatory Deposits; Bartholinitis; Inguinal Adenitis.

The complicating acute gonorrheal joint affections have been previously described at length. Again it should be stated that the family physician or specialist, whoever may first see the case, cannot do better than to primarily remember Bier's treatment. Nowhere else is its effect of such truly magic character as here.

Acute Gonorrheal Joint Affections.

That chronic cases of gonorrheal joint inflammation and joint stiffness are still amenable to great improvement under obstructive as well as hot-air hyperemia has been demonstrated and mentioned above.

Chronic Gonorrheal Joint Inflammations.

Of hyperemia in venereal ulcer and hard chancre little is known to date; in fact, it seems to have been tried to a very limited extent only in specific infection. There has been no benefit from the treatment in ulcus molle in the acute stage, while callous ulcers have shown improvement. It certainly seems that it might be worth while to ascertain how the spirochæta pallida at the place of the primary lesion will react, whether or not hyperemic treatment alone or in combination with other remedies will prevent generalization of the infection.

Primary Specific Lesions.

Among the chronic infections tuberculosis of the prostate and testicles, inclusive of seminal vesicles, takes first rank.

Tuberculosis of the Prostate.

So far tuberculosis of the prostate is an incurable disease. The partial or total extirpation of the gland in these cases has given but poor results. Under general hygienic

régime and topic applications, the disease has behaved rather refractorily. It is still the crux of genito-urinary surgery, and usually the beginning of a most tormenting malady. Frequently gonorrheal inflammation paves the way for the invasion of the tubercle bacillus in patients so disposed.

It is to be hoped that hyperemic treatment is destined to bring relief in this drought of efficient methods. But if anywhere, then here patience and preseverance on the part of the patient as well as the attending physician are required.

However, in the face of his intense suffering, the patient will probably be more than willing to give the treatment a trial, especially if he be told of the splendid results obtained with the method in surgical tuberculosis in other localities. It is up to the specialist now to improve the armamentarium in order to render feasible the application of the treatment also in this class of cases.

Tuberculosis of the Seminal Vesicles.

Incidentally with the prostate, the seminal vesicles, if affected, could be subjected to hyperemia by way of the rectum.

The attempt to work through the posterior urethra with suction glasses of special construction, while not very plausible, might yet be worthy of consideration, in connection with the attack through the rectum.

Tuberculosis of the Testicles.

Tuberculosis of the testicles has already been discussed in a previous chapter. (See pages 138–142.)

The refractory behavior of syphilitic affections in general under artificial hyperemia has there also been mentioned.

Descending Urinary Tuberculosis.

The surgery of the kidneys, ureter, and bladder will probably derive less benefit from artificial hyperemia than is expected in the genital sphere. Radical operative procedure will, no doubt, continue to wield the scepter here, although it would seem, in view of the excellent results obtained with hyperemia in tuberculous disease in other localities,

that a trial of the same in inoperable tuberculous lesions of the urinary system should not be omitted. Of course, we shall continue to promptly extirpate one kidney, if found to be the seat of a descending trouble principally in the early stage. But in those desperate cases, in which the remaining kidney, too, has become affected, and ulcerative catarrh of the trigonum of the bladder has set in, giving rise to such almost intolerable suffering, it certainly seems that artificial hyperemia with suitable glasses should be given a very careful trial, especially in the female. A cup with a properly shaped window applied to the anterior wall of the vagina (Fig. 90), might exert a beneficial influence upon the base of a tuberculous bladder and help, in conjunction with topical applications, in bringing to cicatrization these obstinate ulcerations. Surely, every addition to our therapeutic resources in this sad and trying chapter of urinary surgery should be welcome.*

Many of these remarks, hinting at possible future uses of the method, are made merely for the purpose of starting clinical research in a direction where useful methods are so sorely needed. May some of these suggestions soon be taken up and successfully carried out by the numerous admirers of Bier's fascinating work.

*With reference to hyperemic treatment of a tuberculous affection of the remaining kidney, after nephrectomy for a descending tuberculous process, it might be suggested to perform nephropexy after extensive decapsulation, or partial resection of the kidney according to findings, under spinal anesthesia, and then apply regularly obstructive hyperemia by means of large suction glasses in the respective lumbar region for many months. The well-known depth-effect of this method might prove of benefit, all the more, if the patient could be placed under a general hygienic régime.

CHAPTER VIII.

HYPEREMIC TREATMENT IN OTOLOGY.

Acute Otitis Media with Mastoiditis; Exacerbation of a Chronic Middle-ear Inflammation.

A new and promising field of usefulness has been opened up to obstructive head hyperemia (extensively explained above, on pp. 38–41) in the treatment of inflammations of the middle ear and the complicating mastoiditis. Unassailable proof has been rendered, principally at Bier's own clinic, under the supervision and coöperation of a well-known ear specialist, that a large percentage of cases of acute otitis media purulenta with mastoiditis, as well as of acute exacerbation of old middle ear inflammations, can be cured without any major operation.

Very recent cases heal under obstructive hyperemia alone. If inspection of the drum membrane suggests an accumulation of pus in the middle ear, paracentesis is promptly done, or a former perforation is dilated. With continued artificial hyperemia the fever usually drops quickly and the inflammatory process, with its pathognomonic pain, tenderness, redness and swelling over the mastoid, gradually subsides.

Abscess over the Mastoid Process.

If, after the auricle has been pushed forward the soft parts over the bone suggest the presence of pus, an incision of sufficient size is made to allow of thorough evacuation of the pus. This can be done under local anesthesia. Here, again, no drainage is employed; only a loose aseptic gauze dressing is placed over the wound. The hyperemic treatment is continued and, in many cases, will suffice to effect healing.

Acute inflammatory processes of the temporal bone yield to obstructive hyperemia like acute osteomyelitis of the extremities. If the treatment be applied in the beginning, the entire process may be rendered abortive. If an abscess has formed, this must be incised; the subsequent occurrence of necrosis can thus be prevented.

Technique.

The elastic band around the neck is worn regularly for ten to eleven hours twice per day, or uninterruptedly for twenty-two hours with two hours' intermission. A correct technique is all-essential. The head being abundantly provided with blood, but gentle tension of the neck-band is sufficient to produce a marked and satisfactory hyperemia.

In acute cases the resulting edema of the face may be very pronounced. This, however, should not deter the attending surgeon from continuing the treatment, as it is just these cases that promise best results.

After improvement becomes apparent—*i.e.*, after the fever and tenderness over the mastoid process have disappeared—the time of application of the band is *gradually* shortened by two hours each day, until a cure has been accomplished.

This gradual diminution of the duration of the hyperemia acts as a preventive against a recurrence of the symptoms. *Hyperemic treatment must never be stopped abruptly.* There must be no antiseptic irrigation or insufflation by way of the auditory canal. The latter is gently wiped out with a swab of moist cotton twice per day. It is packed loosely with sterile cotton or gauze, which has to be changed frequently, according to the amount of secretion.

The patient may be out of bed as soon as he has become afebrile.

In some cases improvement is rather slow. This should

not, however, make the surgeon feel that he has to operate. We know of one case of acute suppurative otitis media and mastoiditis which showed very little improvement at the end of four to five weeks, and yet was finally cured under persistent hyperemic treatment. Of course, it requires faith in the method, thorough mastery of its technique, and careful supervision of the patient to continue the hyperemia in the face of such slow convalescence. However, the functional result with regard to the degree of hearing is usually brilliant.

There is no entire unanimity of opinion among otologists as to when trephining of the mastoid process is indicated. Even the most experienced men have at times been surprised not to find pus where is was surely expected. Any method which helps to solve the difficulty of establishing the correct indication for operation must, therefore, be welcome.

On basis of the experience so far had with hyperemic treatment in this class of cases, it can be definitely stated that many an operation of trephining will become unnecessary, if hyperemia be promptly started and correctly carried out in the event of a threatening or beginning mastoid complication.

Intracranial Complications.

Of course, the surgeon must be on his guard lest complications arise. Sinus-phlebitis and brain-abscess require prompt operation, while a threatening meningitis may probably be prevented or, if already present, beneficially influenced by obstructive hyperemia. There is no need of barring other modes of treatment—*e. g.*, lumbar puncture—slight though the benefit derived from this has been.

Chronic Otitis Media; Cholesteatoma.

In chronic cases of otitis media or those of cholesteatoma, artificial hyperemia without operation should be *discour-*

aged. Most of these are strictly surgical cases, although in the slow healing of the bone cavities following extensive mastoid operations, the neck-band will often prove of great help in hastening convalescence.

Diseases of the Labyrinth.

It must be tempting to experiment with head hyperemia in many of the intractable diseases of the labyrinth of the ear, particularly if due to chronic anemia.

In closing this interesting chapter, the hope is expressed that otologists will take up Bier's treatment and give it a fair test in suitable cases. Much work is yet required in this field, and it must be approached in an unprejudiced manner. Surely otologists cannot shut their eyes or ears to what has already been accomplished in acute mastoiditis with hyperemia.

Some of the Many Questions Still Awaiting Solution.

Some of the many interesting questions that still await solution in connection with hyperemia in otology are, according to Bier, the following:

1. Do acute ear inflammations due to different causes react differently to artificial hyperemia?

2. Can chronic cases of otitis media when there are no sequestra and the bone cavities are filled with granulations be benefited by hyperemia alone?

3. Is it advisable to use hyperemia in the presence of sinus thrombosis and brain abscess?

4. Should we confine ourselves to the use of the elastic neck band after an abscess over the mastoid has been opened, or may we have recourse to the suction glass also?

It is clear that the tests necessary to render possible correct answers to above questions are best made in well-conducted hospitals and clinics. In private practice they are

feasible only if a nurse, who has thoroughly grasped the principle of hyperemic treatment, can be in constant attendance upon the patient under the direction of the specialist or his assistants.

In all the ear cases observed at Bier's clinic the treatment was administered by the same assistant.

CHAPTER IX.

HYPEREMIC TREATMENT IN OPHTHALMOLOGY.

The therapy for the treatment of diseases of the eye also seems to have been enriched by Bier's treatment. Obstructive hyperemia, by means of the neck-band as well as with the help of suction glasses, is here of value. In view of the delicate construction of the eye, local treatment naturally demands extreme carefulness on the part of the operator.

The question whether gentle head-hyperemia will influence the interior of the eye also, has not been definitely settled as yet. Still, sufficient proof seems to have been rendered for the assertion that the various membranes of the bulbus, inclusive of disc and retina, participate in the effects of a moderate hyperemia, such as results from the application of the neck-band.

Progressive Optic Atrophy.

It seems to have been proven by the fact that marked improvement from this method has recently been seen in a few cases of progressive optic atrophy with pronounced anemia of the optic nerve, a result which, *à priori*, seems but natural and altogether plausible, provided the trouble has not advanced too far.

The inflamed eye answers better to obstructive hyperemia than the one in which the circulation is normal, same as this is seen, *e. g.*, in the leg which harbors an inflamed focus.

Technique.

The technique is the same as in the case of other inflammations of the head and cranial cavity; the elastic band remains in place for eleven hours twice a day.

Acute Dacryocystitis.

Brilliant has been the success of the treatment in acute dacryocystitis with abscess formation.

Parenchymatous Keratitis.

Also other acute inflammations of the eye—*e.g.*, parenchymatous keratitis—have been favorably influenced by hyperemia.

Sympathetic Ophthalmia.

It is to be expected that cases of sympathetic ophthalmia will yield to obstructive hyperemia, particularly if the latter be applied at an early stage of the trouble.

Inflammatory Diseases of the Eyelids and Conjunctiva.

For inflammatory diseases of the eyelids and conjunctiva suction hyperemia is best suited. The size of the cup must be adapted to the specific purpose for which it is required. The same is placed directly over the diseased spot

Sty.

as in cases of sty (Fig. 91), or it covers the entire orbit. From the rubber tube connecting cup and bulb a branch

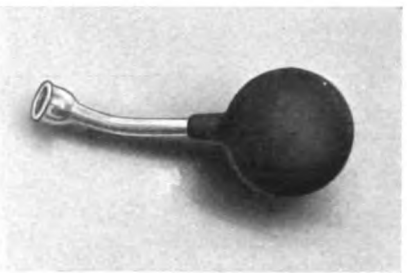

Fig. 91.—Suction glass for sty.

springs, which, in turn, connects with a manometer. For the eye this, surely, is an important addition, which is unnecessary for other parts of the body. It has been found that it is unwise to exert a negative pressure beyond twenty to thirty millimeters for children, and forty to fifty millimeters for adults. The pressure is easily gaged by allowing the compressed bulb to slowly expand until the desired degree of suction is obtained, as indicated by the manometer, when an artery forceps is applied to the tube, thus checking further suction. A too high degree of suction will cause localized punctuated extravasation of blood and a bluish edema, which will last for days.

If no manometer is at hand, the patients' own feeling here, too, must be the guide for the correct degree of negative pressure. While they should experience a sensation of suction on the lid, they must not feel any pain. There may be some watering of the eye, which, however, ceases with the interruption of the treatment. The function of the eye remains unimpaired. Not in a single instance has harm been done by artificial hyperemia.

The treatment is usually given two to three times a day, for fifteen to thirty minutes, without intermission. It does not necessitate any interruption in the patient's regular work, except for the actual time of application.

In the event of abscess formation the pus must be evacuated, same as this has to be done in any other part of the body. A small incision will suffice. Curettement of the cavity may be added at once. If suction is then promptly resorted to, this will often materially hasten convalescence.

The hyperemic treatment of the eye should never be given into the hands of the patient or nurse, but should be carried out by the specialist himself.

It is by no means intended that hyperemia should supersede the other useful methods in vogue in those cases of local inflammation. On the contrary, there are conditions in which its application may be contraindicated or not feasible, and here, of course, the time-honored treatment by incision, curettement and moist heat must be resorted to. But it certainly is worth knowing that this new therapeutic agent is also of use in ophthalmology, and that much can be accomplished by it either alone or in conjunction with other methods, in simple as well as in the more serious cases, as also in those that refuse to yield to any of the procedures hitherto employed.

Artificial hyperemia, therefore, seems entitled to the most careful consideration on the part of ophthalmologists.

CHAPTER X.

HYPEREMIC TREATMENT IN RHINOLOGY, PHARYNGOLOGY, AND LARYNGOLOGY.

Acute Coryza.

Among the diseases of the nose, acute coryza holds first place. It can often be checked within twenty-four hours under obstructive hyperemia by means of the head-band, if the latter be applied as soon as the "severe cold" has made its appearance. The band should remain in place for twenty-two hours per day, or twice eleven. Of course, not every case can be overcome in this way, but there is no one method in medicine that can cure every case. Results are naturally less satisfactory if the cold is but a part of a general infection (influenza). Other remedies may be employed besides the hyperemic treatment.

Acute Frontal and Maxillary Sinusitis.

The same beneficial effect may be observed in the complicating acute affections of the frontal sinus and the antrum Highmori. There are many patients who regularly suffer from acute catarrhal inflammation of these cavities in connection with a severe cold. A sufficient number of cases are on record in which the application of the elastic neck-band, *immediately* after the onset of the first symptoms, has prevented the further development of this most annoying and often obstinate complication, to warrant us in recommending this head hyperemia as a highly efficient prophylactic measure in these cases.

Chronic Diseases of the Nose and Its Accessory Sinuses.

Obstructive hyperemia by means of the suction glass applied through the nostrils (Fig. 92) has been extensively tried for diagnostic purposes as well as for the treatment of suppurative affections of the accessory sinuses, including ozena. However, specialists are still greatly at variance as regards its value in these affections.

Dry Catarrh of the Upper Air Passages.

Good results have been obtained by both suction and constriction in atrophic processes of the mucous membrane of the nasopharynx.

Hay Fever.

As a matter of course, hyperemia has also been tried in hay fever, this crux of rhinologists, and it has given much relief even in obstinate cases. It seems worth bearing in mind when called upon to treat such cases.

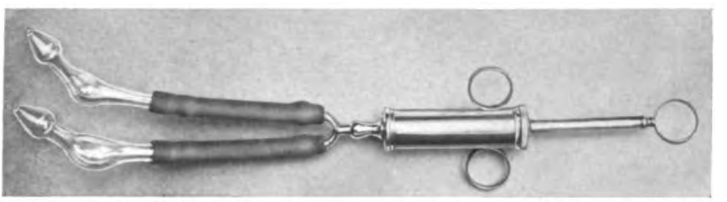

Fig. 92.—Suction apparatus for the nose. Each of the glass tips is introduced into one of the nostrils. By rarefying the air with the help of the suction pump, pus from the sinuses communicating with the nasal cavity is aspirated. Rhinologists are still greatly at variance with reference to the benefit of this procedure, also for diagnostic purposes.

Acute Tonsillitis.

In acute angina obstructive hyperemia with the neck-band has brought but subjective improvement; the use of the suction glasses, however, has proved of value. Cups of suitable shape have been constructed; they are worked with a rubber bulb. Various sizes of these cups should be on hand (Figs. 93 to 95), and the one just large enough to grasp the tonsil first tried. If it does not work or causes pain, the next larger or smaller size should be tried, until one is found that produces the desired vacuum. The fear that its presence irritates the pharynx or induces

the act of swallowing or causes gagging is unfounded, so long as the uvula and soft palate are not touched. The always increased amount of saliva is made to run off by making the sitting patient slightly turn his head forward; the one in a recumbent position is moved to the edge of the bed and placed in a latero-abdominal posture. The cup is best put in place by pressing the tongue down with it. If it be used for aspiration, to procure material

Fig. 93.

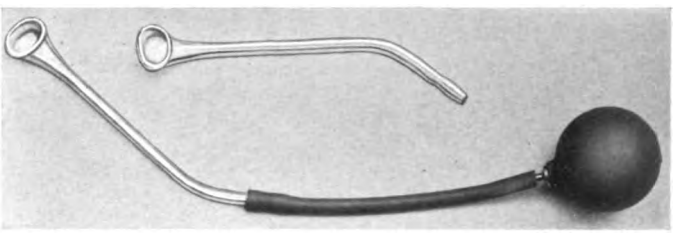

Fig. 94.

Fig. 95.

Figs. 93 to 95.—Suction glasses for the tonsils. The three styles here shown should at least be on hand when using hyperemic treatment for tonsillar affections.

for bacteriologic examination, a spatula should take care of the tongue.

Time of application, as usual, *i. e.*, the cup remains in place for five minutes; it is then removed for two to three minutes, this manœuver being repeated during half an hour, twice or three times per day. The glasses should be boiled after each sitting and the rubber bulb rinsed out with lysol or bichlorid solution. Effect: marked and prompt subjective improvement, as shown in greatly

diminished pain in swallowing, principally in acute cases with pronounced swelling, due to seropurulent transudation into the tonsillar tissue, and abbreviation of the course of the disease. Strange to say, the white plugs are not aspirated, but come loose gradually only.

No harm has ever been done by this treatment, even when it was not successful.

Also in these cases, artificial hyperemia is not claimed to be a substitute for, but an addition to existing remedies.

Chronic Angina.

In patients suffering from unilateral pain of the throat, radiating up to the ear, and complicated with *fœtor ex ore*, suction over the seemingly healthy tonsil in the interval may be successful in aspirating a white plug—detritus with bacteria—from the depth of a lacuna, and therewith cure the patient.

Hypertrophic Tonsils.

It seems that large but flat tonsils that cannot be grasped with the tonsillotome yield to the prolonged, faithful application of the cup; a procedure which, in certain cases, competes favorably with the galvanocautery.

Tuberculosis of the Larynx.

It is to be expected that early cases of laryngeal tuberculosis, the representative of chronic infectious inflammation of the larynx, will prove amenable to obstructive hyperemia with the elastic neck-band, applied below the level of the larynx.

CHAPTER XI.

HYPEREMIC TREATMENT IN NEUROLOGY, INCLUDING PSYCHIATRY.

A promising field for hyperemic treatment seems to lie in the direction of nervous and mental diseases. Its pain-reducing power being the most striking characteristic of Bier's treatment, it has proven particularly efficacious in diseases that are extremely painful, without showing any marked anatomic changes; *e. g.*, neuralgia.

Neuralgia. Here, again, only arterial hyperemia (by means of hot air) is of benefit. Obstructive hyperemia has been found of no value. It is advisable to combine the treatment with massage in the following manner: The affected area is irrigated, as it were, with the hot air, the masseur directing the tube with one hand, while he rubs or kneads the parts with the other. This combined method has given excellent results. A simple apparatus, such as shown in Fig. 61, which is heated by gas, will answer the purpose.

In hospitals and clinics, an electric hot-air douche is preferable, as it is simpler to handle.

Sciatica. Among the various forms of neuralgia, sciatica is the one that has proved most responsive to hot-air treatment, both by means of the douche (Fig. 62) and the box, although improvement is but gradual in this class of cases, especially the chronic type. In obstinate cases bloody stretching of the nerve is indicated.

Tic Douloureux. Neuralgia of the fifth nerve, too, often yields to hot-air massage, sometimes even in cases in which alcohol injection

or operation seemed indicated. The patient assumes a comfortable position, seating himself in front of the douche, and allows the hot air to play on the painful area. (Fig. 61.) Slowly the hot-air tube is brought closer and closer to the limit of the patient's endurance; sometimes it becomes necessary to produce a burn of the first degree in order to relieve the condition, but, as a rule, this is not necessary. In severe cases, hot-air massage is preferable. The pains disappear gradually, never suddenly. Duration of application: about one-half hour daily, with short intermissions. The exact period of treatment must be determined by the attending physician.

Headache.

The induction of a mild degree of head hyperemia by means of the elastic neck-band has proven an efficient means of dealing with headache. The headaches due to anemia have shown best results, although those attributable to suppurative and tuberculous meningitis have, likewise, been greatly alleviated.

Diseases of the Central Nervous System.

There has always been a drought of useful therapeutic measures in this chapter of medical science.

It has not been determined as yet which form of hyperemia will give best results. Up to the present, head hyperemia with the elastic band around the neck has been used. Perhaps suction hyperemia applied directly to the skull would also exert a beneficial influence, in view of its far-reaching depth effect.

Chorea.

A number of cases of chorea minor are reported by Bier to have reacted most favorably to head hyperemia, the bandage being worn twenty-two hours per day. Huntingdon's chorea and a symptomatic case due to a brain tubercle have answered less favorably to the treatment. Further experiments would be desirable.

Epilepsy. In epilepsy hyperemic treatment has brought temporary improvement in decreasing the frequency of the attacks and the headaches. Further tests in homes for epileptics would be of value in determining the usefulness of the method in these cases, as far as they are not amenable to operative treatment.

Mental Irritability; Melancholia. Hyperemia by means of the neck-band has been tried with some success in this class of cases. Of course it is not to be expected that any cures will be effected; still, the treatment represents a further addition to the therapeutic resources of the specialist that has proven of particular value in relieving the headaches.

No beneficial effect has thus far been noted from the treatment in maniacs and depressed conditions of the mind.

It is to be hoped that physicians in charge of asylums for patients thus afflicted will take up the subject and help draw definite lines as to the usefulness of artificial hyperemia in mental disorders.

Spinal Meningitis. Since meningeal inflammations of the brain can be treated to advantage by means of obstructive hyperemia, as has been stated above, it is but logical to expect that suction hyperemia will exert the same beneficial influence upon the meninges of the cord. It has been noted again and again that this form of hyperemia will reduce the pain,—for instance, in Pott's disease,—thus proving that it reaches the body of the vertebræ. It is to be assumed that the cord would share with the vertebræ in the benefits derived from the increased blood supply.*

* With the intention of drawing blood from the depth to the surface, issues and the active cautery have been used alongside the spine, as long as medicine has existed. It is interesting to note that these remedies produce a chronic artificial hyperemia in the deeper tissues, instead of the intended anemia. Ample anatomic proof has been rendered in corroboration of the truth of this statement.

Poliomyelitis.

Acute (epidemic) poliomyelitis deserves special mention. Bier himself calls attention to the probable value of hyperemic treatment here. According to observations, which have not yet been published, hyperemia promises a ray of hope in this disease, which leaves both doctor and patient at the mercy of fate.

Lumbar Puncture.

Before closing the chapter on diseases of the nervous system, Bier's belief as to the true cause for the improvement, usually noted after lumbar puncture, for instance in meningitis, should find a place. He avers that a temporary hyperemia of the cord, perhaps also of the brain, is produced by the withdrawal of a larger amount of cerebrospinal fluid, and that it is mainly owing to this hyperemia that the condition improves. The same he believes to be true in the cases of ascites treated by puncture, holding that a hyperemia of the abdominal organs is created by the withdrawal of the ascitic fluid; and, likewise, in cases of evacuation of a pleuritic exudate. In all these cases, he claims, the relief experienced is attributable not to the mere withdrawal of the fluid but to the hyperemia resulting therefrom.

CHAPTER XII.

HYPEREMIC TREATMENT IN DERMATOLOGY.

The benefit derived from hyperemia also in the treatment of diseases of the skin, only furnishes additional proof of the great utility of this new therapeutic agent.

Skin lesions, in which all the remedies of the pharmacopœia had been tried without effect, yielded as soon as the change was made from a therapy on a chemical to that on a physical basis.

Both forms of hyperemia find employment in the treatment of skin diseases. Their boundary-line has not yet been clearly defined.

Acute Eczema, Acne, Sycosis, Psoriasis, Diseases of the Nail.

Obstructive hyperemia by means of the bandage as well as the suction glasses, has been recommended for acute eczema, acne, sycosis vulgaris et parasitaria; active hyperemia for psoriasis and mycotic diseases of the nail.

Chronic eczema has reacted favorably to both arterial and venous hyperemia.

Keloids.

There seems to be no better treatment for keloids than obstructive hyperemia.

Alopecia Areata.

The suction glasses have brought improvement in alopecia areata.

Lupus.

They should also be tried in tuberculosis of the skin (lupus), particularly when occurring in the face of females, before recourse is had to the *x*-rays or extirpation and subsequent grafting. The grafts, though taken from the soft skin of the arm, always look different from the skin

of the face; besides the grafted area does not participate in temporary circulatory changes; *e. g.*, blushing. A number of cases of lupus of the face permanently cured by means of obstructive hyperemia with suction glasses are on record. Dermatologists will do well to add artificial hyperemia to their armamentarium.

CONCLUSION.

The above pages bring in brief form what is known about Bier's treatment up to the present time.

It has been stated above, and is herewith repeated, that the large type used in this book refers to affections in which the method has been sufficiently tried to entitle it to universal and unqualified recommendation, whereas the small type indicates the directions in which hyperemic treatment promises good results, but has not yet been thoroughly tested.

The fact that artificial hyperemia has already found use in such a variety of different diseases, seems to speak for the correctness of Bier's prophecy made some years ago: "This remedy, used by nature in such a profuse measure, to combat all sorts of lesions, is destined to be far more extensively employed than has hitherto been attempted."

Of course, it must not be assumed that now the millennium has come; that all that is necessary to effect a cure is to apply the elastic bandage, glass cup or hot-air box. Far from it. If the rules laid down in this book are not closely followed; if, in cases of acute and chronic inflammations, a correct diagnosis, even as to details, does not underlie the treatment, the trouble will get worse, instead of better under hyperemic treatment.

If, on the other hand, the physician strictly follows the directions given and, above all, is mindful of the fact that a *gentle hyperemia only* is required to produce the desired effect, at least in cases of acute infectious inflammation, in other words, that *a "too much"* is absolutely injurious, he will soon become convinced that in Bier's treatment we have a most powerful and efficient remedy, altogether unlike any other known to us before. He will then grasp the full truth of Bier's new teachings that have revolutionized all our former theories and ideas regarding the nature and significance of inflammations, proclaiming the latter a salutary process, representing nature's own weapon in fighting the invading foe, a phenomenon that must be favored and encouraged, not combated. The fact that artificial hyperemia, properly applied, can prevent the outbreak of a threatening inflammation, or the spread of a beginning one, is absolute proof of this assertion.

It has been pointed out that hyperemic treatment has its greatest triumphs when applied prophylactically. Regarding this there is no dissenting voice. Even those who do not as yet accept Bier's teleologic explanation of the purpose of inflammation nor the conclusions he has drawn therefrom as a basis for treatment, agree as to the value of the method in this direction. But do they not thereby silently recognize the very principle Bier has been trying to establish, namely, that by merely increasing the volume of blood alone—nature's weapon—a cure can be effected? The earlier we assist nature in her curative efforts the greater are the chances of success.

Like a red thread runs through the convincing and inspiring writings of Bier, the many publications of his

pupils and followers, as also through the text of this book, the urgent appeal for an early and correct definition of the seat and character of the inflammation, and prompt resort to artificial hyperemia. Only in this manner the greatest amount of good can be accomplished. Likewise has it been emphasized, again and again, that whatever pus may have formed must be promptly evacuated.

It stands to reason—as it has been pointed out above—that, if the destructive work of the invading bacteria has been allowed to go on unchecked, if thrombosis of the smaller veins within the focus of infection or even necrosis has set in, nothing in the world can save such a part. The utmost that even the best of methods can do in that event is to assist in eliminating the infective material and then help in the reconstruction. And this requirement Bier's method fulfils.

Yet, hyperemic treatment is not a panacea. It is just a new and fascinating but very powerful therapeutic agent on a physical basis, an agent which has its indications and dosage, the same as any other remedy. There is much to learn about it yet. We are only just beginning to appreciate its possibilities. Although it has been known for the last fifteen years as an efficient remedy in the treatment of tuberculous disease, its application in the treatment of acute infections is of but comparatively recent date; it is still on trial in every one of the branches of our science.

It now behooves the medical profession to accept whatever proof has been rendered, and to work conjointly in further developing the uses of this promising remedy, to

establish the indication as to when it should be employed and when it is contraindicated.

Individual training, tact, and judgment are essential to success. It will not be an easy task for the surgeon to decide just when hyperemic treatment may yet be employed in a somewhat advanced case, and when prompt operative intervention be imperative. He will oftener than before move along the borderline between conservative and radical treatment. But when he masters the details of hyperemic treatment he can render better service to his patients than he could without it. He will be able oftener to prevent disaster as well as dangerous and protracted illness.

It must be remembered, however, that hyperemic treatment in acute diseases requires more time and attention than radical work with the knife, chisel, or saw. A busy man cannot alone undertake the treatment of many such cases; he needs trained assistants in private as well as hospital and dispensary practice.

If such assistance be not obtainable, it were better not to employ the method, for the careful supervision of patients under hyperemic treatment is of paramount importance. Many of the failures and disappointments are directly due to improper and incorrect use of the method; in fact, actual harm has resulted therefrom. Even in our hospitals we shall have much to contend with in this respect. With our ever rotating staff of physicians and nurses a correct and truly beneficial use of Bier's treatment is an impossibility. We must make special provision for the efficient carrying out of this treatment, besides giving regular practical courses in hyperemic

treatment to both doctors and nurses. In other words, we must adapt the method to the usages prevailing at our hospitals. Matters will improve as soon as hyperemic treatment is taught in the courses of college instruction.

An arrangement which, in our opinion, should at present be made in every hospital, is to get two of the younger men of the staff to volunteer to *superintend*, during their hospital career, the proper carrying out of the method in all cases. The same should be done in the various departments of the dispensaries. The small sacrifice of time and work will, by virtue of the experience gained, revert to their own benefit in the course of their entire future career.

As matters are at present, Bier's treatment is a step-child in our public institutions; then it would probably become one of the favorites.

Surely, the present achievements and large possibilities of Bier's treatment call for united action on the part of the profession to further facilitate and promote its usefulness.

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